Imperial geological survey of Japan

Chishitsu Chōsajo (Japan)

IMPERIAL GEOLOGICAL SURVEY OF JAPAN

WITH

A CATALOGUE OF ARTICLES

AND

ANALYTICAL RESULTS OF THE SPECIMENS OF SOILS

EXHIBITED AT

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THE IMPERIAL GEOLOGICAL SURVEY OF JAPAN

DEPARTMENT OF AGRICULTURE AND COMMERCE

TŌKYŌ, 1904

PROF. DR. M. FESCA
Late Chief Agronomist

DR. E. NAUMANN
Late Chief Geologist and Topographer

O. KORSCHELT
Late Chief Chemist

LATE DR. T. HARADA
Vice-Director

T. WADA
Ex-Director

DR. K. NAKASHIMA
Late Chief Geologist

DR. J. TAKAYAMA
Late Chief Chemist

DR. N. TSUNETŌ
Late Chief Agronomist

Y. ŌTSUKI
Geologist

K. INOUYE
Geologist

N. KANEHARA
Geologist

T. IKI
Geologist

DR. S. ŌTSUKA
Geologist

T. OGAWA
Geologist

DR. T. SUZUKI
Chief Geologist

DR. T. KOCHIBE
Director

S. SEKINO
Chief Topographer

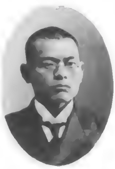
B. MINARI
Agronomist

M. MATSUOKA
Agronomist

M. KAMOSHITA
Chief Agronomist

S. YAMANOUCHI
Chemist

S. SHIMIZU
Chief Chemist



S. TSUKAMOTO
Chemist

F. KOBAYASHI
Agronomist

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IMPERIAL GEOLOGICAL SURVEY OF JAPAN

HISTORY

The first geological examination of Japan (exclusive of the Hokkaidō, Ryūkyū and Taiwan)[1] was made by MR. T. WADA, in 1878, under the Geographical Bureau (*Chiri-Kyoku*)of the Home Department, the provinces of Kai and Izu being then mapped out. At the end of the same year, DR. EDMUND NAUMANN, then Professor of Geology in the Tōkyō University, advised the establishment of a systematic geological survey of the Empire, and submitted a plan for the same to the Minister of the Home Department. In May 1879, that plan was adopted, and the present Imperial Geological Survey was organised and placed under the direction of DR. E. NAUMANN. As much time was spent in making the necessary preparations, the survey itself was not begun till the following year. In 1881, the Government established the Department of Agriculture and Commerce (*Nōshōmushō*), and transferred to it the direction and work of the Geological Survey as a section of its Agricultural Bureau; but in 1882, the Geological Survey was made independent of this Bureau, under the name of *Chishitsuchōsajo* (Geological Survey). It was now felt, in the interests of industries rapidly developing in the Empire, that, as far as possible, the investigations carried out under the Survey should be directed to matters promising to be of practical importance, such as the examination of ore deposits,

[1] For the geological survey of the Hokkaidō and Taiwan see Appendices I and II.

arable soils, and other forms of mineral wealth, with the object of affording assistance to mining, agriculture, and other branches of applied science. The Survey was organised in accordance with this view and MR. T. WADA was made Director. The work in the Topographical and Geological Sections was placed under the immediate control of DR. E. NAUMANN,[1] while the Agronomical and Chemical Sections were under the charge of Prof. DR. M. FESCA[2] and MR. O. KORSCHELT respectively. In 1885, the late DR. T. HARADA succeeded DR. E. NAUMANN, in the direction of the Geological and Topographical Surveys, and since 1884, the work of the Chemical Laboratory has been under the direction of MR. J. TAKAYAMA who succeeded MR. KORSCHELT. In 1891, ill health obliged DR. T. HARADA to resign his office and in 1893, MR. T. WADA having retired, MR. T. KOCHIBE, then Chief of the Geological Section, was appointed Director. In 1894, Prof. DR. M. FESCA was relieved of his office and pensioned in recognition of his valuable services extending over a period of twelve years. In subsequent years, the Chief of every Section has occasionally been changed, but the work of the Survey is now continued with very few deviations from the plans laid down by DR. E. NAUMANN and Prof. DR. M. FESCA.

The Survey has sent delegates to attend the International Geological Congress, since its seventh session, the delegates being

DR. T. KOCHIBE and DR. N. TSUNETŌ,
to attend the 7th I. G. C. (St. Petersburg, 1897)
DR. T. KOCHIBE, „ „ „ 8th „ „ „ (Paris, 1900)
K. INOUYE, „ „ „ 9th „ „ „ (Vienna, 1903)

The Geological Survey received gold and silver medals at the Paris Exposition, 1889, for its series of geological, agronomical and topographical maps exhibited there, and three medals at the World's Columbian Exposition, 1893, for its exhibits of maps,

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[1] At first MR. O. SCHUTT was the Chief Topographer but for only one year.

[2] DR. LIEBSCHER directed the work of the Agronomical Section prior to Prof. DR. FESCA, but only for a short time.

typical specimens of soils, minerals, rocks and fossils. Also, at the Brussels Exposition in 1897, and at the Paris Exposition in 1900, gold medals and "Grand prix" were respectively awarded for its various exhibits.

ORGANIZATION AND FUNCTIONS

According to the original plan adopted by DR. E. NAUMANN, the objects of the Geological Survey of Japan were to be :—

1. A topographical survey of the whole of Japan except the Hokkaidō: the construction of maps and sections showing the relation and distribution of the different formations, and illustrating the geological structure of the country.

2. An agronomical survey: the construction of maps, showing the characters and positions of soils, and an examination of the soils with the view of preserving and improving their fertility, especially an agronomical survey of those portions of the country not yet under cultivation, but likely to be fit for cultivation; and an inquiry into the quality, abundance and accessibility of such mineral fertilisers as might be found.

3. An examination of ores and coals, of deposits of such materials as might prove useful in the arts and manufactures, of building-stones and materials necessary for other technical purposes.

The scale of the maps as published was to be 1 : 200 000. The single division maps, corresponding to divisions of degree-rectangles, were to extend over 1° of longitude and ½° of latitude. This would make 97 division maps altogether (97 topographical, 97 geological and 97 agronomical maps). Then, if eight maps of each of the above should be finished in one year, the survey would be completed in twelve years. To accomplish the above estimate, the following staff would be required :—

1 Foreign director
12 Japanese geological assistants
1 Foreign topographer
6 Japanese topographical assistants
1 Foreign agronomical surveyor
6 Japanese agronomical assistants
1 Foreign chemist
6 Japanese chemical assistants
6 Japanese cartographers
A number of subordinate assistants and stone-cutters.

Upon economic and other grounds, DR. E. NAUMANN's plan has been modified to the following extent. Beside the separate topographical and geological sheet-maps (scale 1 : 200 000), reconnaissance maps on a scale of 1 : 400 000, are published, which give the general topographical and geological features of the whole country. The scale of 1 : 200 000 for the agronomical maps, being too small to show the distribution of the different kinds of soils in sufficient detail, it has been changed to that of 1 : 100 000. Since the agronomical survey is frequently carried out to meet the wants of a particular prefecture, the maps are made to extend over a *Ken* or *Fu* (prefecture), instead of being determined by longitudes and latitudes. To each geological or agronomical map, an explanatory text is attached. Besides, detailed extra-surveys, geological and agronomical, are often carried out either voluntarily or by request, the results of these surveys being mostly published as maps and reports. Bulletins are frequently published, comprising the results of either geological, agronomical, or chemical investigations conducted by the Survey.

Publications of the Survey can be obtained in most cases on application to its office and are also on sale in Tōkyō.

The numbers and classes of technical officials in the Geological Survey during the past ten years have been as shown in the following table, with the addition of a foreign Adviser in the Agronomical Section in 1894.

STAFF OF TECHNICAL OFFICIALS[1]

	Geologists	Agronomists	Topographers	Chemists	Cartographers	Assistants	Total
1894	6	7	4	8	8	3	36
1895	6	7	4	8	8	3	36
1896	6	7	4	8	8	3	36
1897	6	7	3	7	8	4	35
1898	6	7	3	6	4	4	29
1899	6	6	3	5	3	5	28
1900	6	6	2	6	3	12	35
1901	6	6	2	7	4	8	33
1902	7	6	2	4	2	8	29
1903	7	5	2	2	2	8	26

PERSONNEL OF THE IMPERIAL GEOLOGICAL SURVEY

DIRECTOR:

Tadatsugu Kochibe, *Rigakuhakushi*

GEOLOGISTS:

T. Kochibe (*Director*)
S. Ōtsuka, *Rigakuhakushi*
T. Ogawa
N. Kanehara
E. Tamura
T. Suzuki, *Rigakuhakushi* (*Chief*)
K. Inouye
T. Iki
Y. Ōtsuki

AGRONOMISTS:

M. Kamoshita (*Chief*)
B. Minari
M. Matsuoka
F. Kobayashi

TOPOGRAPHERS AND CARTOGRAPHERS:

S. Sekino (*Chief*)
T. Nakamura
Y. Horiuchi
T. Teramoto
H. Wakabayashi
K. Ōta
N. Sasaki
T. Togawa

[1] Officials engaged in the Oil Land Survey are excepted.

CHEMISTS:

S. Shimizu (*Chief*)   S. Tsukamoto
S. Yamanouchi   M. Naitō

The Survey is divided into four Sections, viz.: I. Geological; II. Agronomical; III. Topographical; IV. Chemical.

I. GEOLOGICAL SECTION

The scope of the geological Section provides for a systematic geological examination of the whole country directed to economic requirements, and to serve as a basis for the agronomical survey executed by the agronomical Section. The work of the Section accordingly ranges itself under the five following heads: 1. Field work. 2. Office work. 3. Production and publication of maps. 4. Preparation and publication of explanatory texts, etc. 5. Collection of specimens and arrangement of a museum.

1. *Field work*:—The geologist examines as accurately as possible the geology of a region selected by the Survey. Having in his hands the topographical maps and route-sketches prepared by the topographers, he adds to them detailed information as to the important geological facts perceived in those regions. Economic mineral deposits or products receive special attention and are examined more exactly. When necessary, he makes sketches of the routes or districts he has travelled and supplies data for the construction of geological maps to be published.

The time allotted for the field work of one geologist for making the survey for one sheet-map, is generally 3 or 4 months. For such work, as the examination of important mining districts; the sources of water-supply; the investigation of districts which have been devastated by an earthquake, a volcanic eruption or a landslip; the proposed locality for a dockyard or harbour,

etc., a more detailed survey is carried out with more accurate instruments.

2. *Office work*:—The specimens collected in the course of the field work are examined physically, microscopically, and chemically, in order to determine their mineralogical, lithological, and palaeontological characters and relations, their geological formation, position, and age, and their possible uses in the arts. The analysis of minerals and rocks, and the assay of ores and other useful substances are however handed over to the Chemical Section. The geologist has next to construct a geological map of the surveyed region with the help of route-sketches and the base maps already alluded to. The geological profiles are constructed on either a true or an exaggerated scale as will best serve the purpose. The map thus prepared becomes the basis of the geological map as published.

3. *Production and publication of maps*:—As has already been mentioned, there are two series of geological maps. The one, called the reconnaissance map, is on the scale of 1 : 400 000, and represents the general geological features of the land; the other, known as the special map or sheet, is on the scale of 1 : 200 000. Upon this the geological formations are delineated in different colours, and the localities of materials of any economic importance are indicated by conventional signs. The sheet thus prepared, is signed by the geologist, who is responsible for the work.[1] Both reconnaissance and special maps are published separately in Japanese and English. Detailed geological maps on a larger scale are also produced when needed for the purposes of the survey.

4. *Preparation and publication of explanatory texts, etc*:—The explanatory text, which is supplied with each geological sheet-map, is written in three chapters. The first treats of the topographical features of the district; the second gives a detailed description

[1] The agronomical and topographical maps published by the Survey are thus signed.

of rocks and different geological formations; the third contains a description of any economic mineral matters. Many profiles, sections and maps are usually included in, or appended to these descriptive texts.

Reports and bulletins, which contain notes of geological surveys and investigations conducted by the Section, are also frequently published by this Section in co-operation with some others of the Sections. These publications are mostly in Japanese.

5. *Museum* :—The specimens of rocks, minerals, ores, fossils, etc, collected by the Geological Section, are properly arranged together with geological maps and sections in the collecting room or museum. Among these, specimens of technically important materials, such as ores, building or ornamental stones, whetstones, inkstones, oils, coals, clays etc. are particularly arranged under separate heads. Specimens of typical Japanese soils collected by the Agronomical Section, are also exhibited in the museum, being arranged according to their physical characters, and are accompanied by the series of agronomical maps published by the Survey.

II. AGRONOMICAL SECTION

The nature of the solid rocks of any land has but slight relation to its agricultural conditions, while the different characters of the weathered products of these rocks, the *soils*, have great influence on the fertility of the country or certain regions in it.

The main object of an agronomical survey in its relation to geology is, therefore, to divide the soils derived from different kinds of rocks into as many types as possible, and to judge of the relative capabilities of these soils for cultivation. Hence the survey does not confine itself to cultivated ground, but extends to promising regions not yet under cultivation and to forest lands. The chief functions of the Agronomical Section are: 1. Field work; 2. Laboratory work; 3. Production and publication of maps; 4. Preparation and publication of explanatory texts.

1. *Field work*:—Making use of the geological maps which have been prepared by the Geological Section, the agronomist puts on his field sketches the distribution of the different soils. He then determines by means of the proper instruments the nature of the subsoil and underlying formations, and draws sections. The relation of soils to their mother-rocks at different stages of weathering is also closely observed and typical samples of the soils and their respective mother rocks are collected with the following notes made on them:—

a. Geological origin and petrographical character of the soils

b. Structure of the ground to a certain depth (if possible, three meters)

c. Depth of the soil

d. Height of the land above sea level

e. Configuration of the surrounding country

f. Underground water level

g. Local climatic conditions

h. Registered value of the land

i. Judgment upon the conditions of actual farming

j. Other agricultural particulars, such as rotations and kinds of crops, manures, possibility of amelioration, etc.

The instruments used in agronomical field work are: boring stick, piedometer, aneroid barometer, thermometer, sketching board with its requisites, hammer, spade, etc.

2. *Laboratory work*:—With the samples of soils collected in the field, the following points are investigated: (*a*) their *mechanical* and (*b*) *chemical composition*; (*c*) their *physical properties*, such as weight, permeability to air and water; (*d*) their *absorptive power*. Also, (*e*) pot experiments are made for the purpose of ascertaining the comparative natural fertility of soils and the effects of fertilisers upon them.

3. *Production and publication of maps*:—The maps published by the Section are based upon those already prepared in the

Topographical Section, on a scale of 1 : 100 000, and are in both Japanese and English. They are issued as prefectural maps, their areas being determined by the limits of administration boundaries (*Fu* or *Ken*), and each map is known by the name of the provinces which it contains. Some special maps are occasionally published when necessary to show the results of special or detailed surveys.

The characters of soils and geological formations are represented on the map by the following cartographic signs :—

a. Geological formations are delineated in different colours.

b. Characters of soils classified according to physical conditions, are shown by inclined lines and crowded spots of various sizes in shades of different depths.

c. Subsoils, to the depth of 3 meters, are indicated by many profiles (scale 1 : 100) along the margins of the map.

d. Those parts marked with inclined lines indicate the kinds of soils not only on cultivated but also uncultivated land (*hara*), and in some cases forest lands.

4. *Preparation and publication of explanatory texts* :—The descriptive texts issued with the maps are based upon the results obtained both in the field and in the laboratory. They are divided into three chapters. The first gives a description of the topographical features of the district, with special attention to the situation of agricultural land and its transport facilities ; the second contains a general account of the agricultural land or region both as to its geological formations, and also as to the properties and fertilisable powers of the soils as determined in the laboratory ; the third contains a discussion of the soils in connection with agriculture and plant-growth, generally. It also discusses the comparative fertility of the soils in connection with the different geological formations.

III. TOPOGRAPHICAL SECTION

The object of this Section is to make topographical maps upon which the geological and topographical features of the country are represented with a reasonable degree of accuracy. The operations of this Section may be classified as :—1. Field work. 2. Office work. 3. Production and publication of maps.

1. *Field work* :—The topographer is usually required to plot the field sheets on the scale of 1 : 50 000, and is provided with perambulater, plane table with its requisites, pocket alt-azimuth instrument, and mercurial and aneroid barometers. The distances are directly drawn upon the plane table sheets in the field ; the heights of mountains, etc., are measured with the alt-azimuth instrument and those of the routes with the barometers. Sketches of profile views of mountains and hills, are taken when necessary. For a detailed survey, theodolite, level, magnetometer, sextant, chronometer, chain, steel tape, etc., are included in the equipment. When necessary, triangulation is carried out and field sheets are plotted on a scale much larger than the one above mentioned.

2. *Office work* :—The field sheets are reduced and drawn on the required scale of the special maps or sheets (scale 1 : 200 000), of the reconnaissance maps (scale 1 : 400 000), of the agronomical maps (scale 1 : 100 000) and also of some other maps. The heights are calculated from the altitude observations and barometrical readings. The astronomical information is supplied from the data furnished by the Trigonometrical Survey of War Department and also from the observations of the Hydrographical Survey under the Naval Department.

3. *Production and publications of maps* :—The topographicaf maps are published on two different scales, one on the scale ol 1 : 200 000, and the other 1 : 400 000. The former bears the name of special maps or sheets and the latter, that of reconnaissance maps. Both are constructed after the modified Flamsteed's projection. The middle meridian is laid down at 136° to the east of Greenwich, and the middle parallel, 36° north latitude.

Each of the special maps or sheets extends over one degree of longitude and half a degree of latitude; and it receives as a heading the name of the most important place, such as town, mountain, etc., which it contains. The enumeration of the sheets is made by a double table, with Roman figures in the zones and Arabic in the columns. Contours are at equidistant curves of 40 meters. When finished, it will comprise 99 sheets (the Hokkaidō, Ryūkyū Islands and Taiwan excluded). The reconnaissance maps are of five divisions, commencing from the north, and each comprising three degrees of longitudes and four degrees of latitudes. Contours are of 100 meters vertical intervals, and the elevation of principal towns, mountains, etc., is written and given in meters (no number given on contours). The various natural and artificial objects are illustrated by different conventional signs. The base is printed black, the water blue and the contour lines grey. Two scales are given below the border, one in kilometers and the other in *ri* (1 *ri* = 3.927 km.). The special and reconnaissance maps are published both in Japanese and English; and they are lithographed.

Topographical maps on various scales, necessary as base of geological or agronomical maps of the Survey are also prepared by this Section.

IV. CHEMICAL SECTION

The work of the Chemical Section is to make analyses of the minerals and rocks, and assays of the ores collected by the Geological Section. Experimental trials of raw materials and of their refined products from chemical and metallurgical works, the valuation of building materials, etc., are made, and the results when they appear to be valuable, are published as information useful in relation to scientific and industrial progress in this country.

WORK

The work conducted by each Section of the Survey is summed up in what follows.

I. GEOLOGICAL SECTION[1]

The reconnaissance survey of the first proposed five divisions has been completed and maps of these divisions have been published, and the survey has since been extended to the other districts of the Empire. The reconnaissance Divisions added are VI, VII, and VIII, and include Formosa, the Ryūkyū Islands and the southern islands of the provinces of Ōsumi and Satsuma.

The first five divisions of the reconnaissance survey were divided into 99 special survey sections or sheets, of which 64 sheets have been published and 6 sheets are being prepared for publication. From the establishment of the survey to the end of the last fiscal year, the following sheets have been published:— Izu in 1885; Yokohama, Chiba, Shizuoka, Fuji, and Maebashi in 1887; Kazusa, Tōkyō, Kōfu, Mito, Ueda, and Nagano in 1888; Nikkō, Kitsuregawa, Toyohashi, Yokkaichi, and Sado in 1889; Asuke, Nagoya, Toyama, and Ishinomaki in 1890; Shirakawa, Ogashima, Ōsaka, Aizu, and Ichinoseki in 1891; Akita and Fukuoka in 1892; Noshiro, Miyazu, Hieizan, Ikuno, and Toyooka in 1893; Tokushima, Akō, and Kumamoto in 1894; Oki, Oita, Okayama, Tobishima, Hamada, Fukushima, and Yahiko in 1895; Kagoshima, Daisen, Sambeyama, and Honjō in 1896; Yoneyama and Fukui in 1897; Marugame, Shibushi, and Sakata in 1898; Saga in 1899; Miyazaki, Sukumo, and Susaki in 1900; Uwajima, Kōchi, and Wakayama in 1901; Koshikijima, Tsunoshima, and Kamaishi in 1902; Kinomoto and Nachi in 1903.

Also, a general geological map of the Japanese Empire (scale 1 : 1 000 000) in Japanese, was published in 1899, the English edition being published in 1902.

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[1] Refer Pl. I (at the end of this work).

The decrease in the number of special sheets published in some years, is due to the greater demands upon the time of the Survey necessary to meet official and private requests for various detailed surveys. These extra-surveys are becoming still more numerous with the extension of mining and other industries. Some of these detailed surveys made since 1890, whose results have been mostly published either in bulletins or in special reports, are as follows:

1890. Datailed survey of Ikuno mine and its adjoining districts; of the coal fields of Buzen and Chikuzen provinces; of the geological structure of Tōkyō Bay, in connection with the construction of a harbour.

1891. Detailed survey of the workable magnetite deposits in the Kamaishi iron mine and its neighbourhood; of Mino and Owari provinces, lately shaken by a severe earthquake; of the Imperial Estate in the Hakone district.

1892. Detailed surveys of the Sennin, Akadani and Taira iron mines; of iron ore localities in Chugoku; of pyrites beds in the outer zone[1] of Japan; of the Ōmori silver mine; of regions destroyed by landslips in the deluged valley of the province of Awa in Shikoku.

1893. Particular examination of some pyrites beds in the districts of the Tenryūgawa; of the iron deposits in Yanahara, Tsugawa and its neighbourhood; of Mt. Azuma,[2] which had been showing intermittent eruptions after long years of repose; of districts yielding building stone around Mt. Ikoma.

1894. Detailed survey of the oil fields of the provinces of Echigo and Tōtōmi; of the phosphate bed in the province of Hyūga; of the magnetite deposits in Kibe and Kokura; of the tectonic line in the peninsula of Awa (in the Main Island).

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[1] See DR. HARADA'S "Die Japanischen Inseln" p. 27 et seq.

[2] The memorable death of the late geologist, S. MIURA, was caused by a wound received by an unexpected explosion of this volcano, when he was engaged in the study by the crater.

1895. A reconnaissance survey of a portion of the Liao-tung peninsula, China (by the order of the Army Head Quarters); survey of the islands of the provinces of Ōsumi and Satsuma. Also a geological survey of the site in Moura harbour for a dockyard and that of a proposed canal across the Tonan peninsula; of Mt. Za-ō and Mt. Kirishima, after eruption; of the iron deposits in the province of Oshima and in Aomori, Hiroshima, Yamaguchi, and Fukuoka prefectures, were made in this year.

1896. An examination of the water-bearing strata of Yokohama, Chiba and Gumma prefectures; the anthracite beds of Akita, and districts in that prefecture which had suffered a severe earthquake; the "placer" region in Yūbari and Sorachi valleys in the Hokkaidō; the coal fields of Miike, Hirado, and Nagato; the regions in Kai around Nishi and Kawaguchi lakes which it was proposed to drain; the sulphur and gold deposits of Rikuzen and Satsuma; and prospecting in regions yielding petroleum, iron ore, and other useful minerals or ores; surveys for the water-supply in Akamagaseki, Kōbe, and also in Kagawa prefecture.

1897. A geological survey of the anthracite field in the province of Ugo; of the colonisation district of Obihiro-*hara* in the province of Tokachi; of oil fields of the province of Echigo; of the Ashio copper mine; of coal fields in the provinces of Chikuzen and Buzen.

1898. An examination of the oil fields of the province of Echigo; of the phosphate districts in the province of Hyūga; of the Sasago and Kobotoke railway tunnels in the provinces of Musashi and Kai; of the military harbour of Maizuru; of the dockyard at Uraga.

1899. A geological examination of the phosphate districts in Nagasaki, Saga, Shizuoka, and Gifu prefectures; of the coal field in the province of Hyūga; of the source of the water-supply of Kōbe; of the geology of the sea-bottom near the Yokohama custom-house.

1900. An investigation of the eruption of the volcano Numajiri-yama in the province of Iwashiro; of landslips in the Handa mining district in the province of Iwashiro; geological researches in Köjyöi Island, Korea; an examination of the source of the water-supply of Moji; of the geology of the sea-bottom near the Yokohama custom-house (continued from 1899); of the geology of the sea-bottom of the area proposed for the construction of a harbour in the Tōkyō Bay.

1901. Prospectings in petroleum localities of the Hokkaidō, Akita, and Tottori profectures; geological investigations of the sea-bottom of the area proposed for the construction of a harbour in the Tōkyō Bay (continued from 1900).

1902. Geological investigations of building stones in Tottori, Yamaguchi, Ibaraki, Tochigi, and Miyagi prefectures; of the sea-bottom of the area proposed for the construction of a harbour in the Tōkyō Bay (continued from 1900); of the water-bearing strata in the neighbourhood of the Kōfu railway station; of the site for a reservoir in Akamagaseki; of the hot-spring of Takeo in the province of Hizen; geological survey of the magnetite deposit of Dorogawa in the province of Yamato; of mineral localities of North China.

1903. Examinations of the alluvial gold district in the province of Tokachi, the Chūgoku mine in Hiroshima prefecture, the tungsten deposit of Kurasawa in the province of Kai, and the Toguchi gold mine in Nagasaki prefecture; geological investigation of the Yamanaka hot-spring in the province of Kaga; the environs of Inokashira-*ike* near Tōkyō, for the construction of a reservoir; examinations of the oil fields of the Hokkaidō.

As has been elsewhere noticed, the explanatory texts, bulletins and other special reports are generally written and published in Japanese. Works which have been published in foreign languages, worthy of mentioning here, are Dr. E. Naumann's 'Ueber den Bau und die Entstehung der japanischen Inseln,' Dr. T. Harada's 'Versuch einer geotektonischen Gliederung der

japanischen Inseln' and 'Die japanischen Inseln, eine topographische-geologische Uebersicht' and 'Outlines of the Geology of Japan' compiled by the officials of the Survey.

II. AGRONOMICAL SECTION[1]

Of the 45 prefectures of Japan (exclusive of the Hokkaidō, Ryūkyū Islands and Formosa), 41 prefectures extending over 66 provinces have been surveyed, 38 being finished and 3 still in progress. Agronomical maps (scale 1 : 100 000) of 35 prefectures have been issued, viz.; Yamanashi, in 1885; Kanagawa and Tochigi, in 1887; Tōkyō and Saitama, in 1888; Chiba, Nagano, and Miyagi, in 1889; Fukushima, in 1890; Gumma, Kumamoto, and Ibaraki, in 1891; Hiroshima, Tottori, Iwate, and Ishikawa, in 1892; Yamaguchi, Ōsaka, Tokushima, and Nagasaki, in 1893; Fukui, Shiga, and Shimane, in 1894; Kagawa, Oita, and Shizuoka, in 1895; Aichi, Akita, and Hyōgo, in 1896; Kagoshima, Insular parts of the province of Ōsumi, Nara, and Miyazaki, in 1897; Okayama in 1898; Yamagata in 1899; Toyama in 1900.

Beside regular work, several special investigations have been made by this Section. The relations of agronomical produce to local climatic and other conditions in various parts of the Empire have been studied, and the results have furnished much information relative to scientific and economical questions in agriculture. Prof. DR. M. FESCA and some of the agronomists of the Section, were engaged in these enquiries in the years 1886–91. During that time, they made practical observations in different parts of the Empire, and Prof. DR. M. FESCA published papers about them entitled—"Beiträge zur Kenntniss der japanischen Landwirthschaft"; "Ueber den landwirthschaftlichen Verhältniss Japans"; "Die Kolonization Hokkaidōs"; etc.

At the request of the Hokkaidō-chō, a preliminary agronomical survey of the lands fit for cultivation was undertaken

[1] Refer Pl. II (at the end of this work).

in 1895 in the interest of the settlers there, and a systematic survey was subsequently carried out in the Obihiro-*hara* of the province of Tokachi, with the basal map on the scale of 1 : 25 000.

Search for deposits of mineral fertilisers had been made by the Section in many parts of the country, during several years before the establishment of the 'Fertiliser Survey' in 1901, and a thorough study of minerals as fertilisers was made, the results of which have been reported in the Bulletin, entitled "Mineral Fertilisers" No. I.

In 1895, pot culture experiments were commenced according to the plan already mentioned. Some of the results of these experiments have been made public as a part of the above mentioned Bulletin. In the summer of the same year, by orders from the Army Head Quarters, a portion of the Liao-tung peninsula (China) was prospected. In 1896, a special agronomical survey was conducted in the district extending over Tochigi, Gumma and Saitama prefectures. The principal object of above survey was to investigate the effect of the polluted water from the Ashio copper mine upon the composition of the soil along the flood plain of the Watarase-gawa into which the said water flows. During 1899–1901, the soil of Kita-aizu-gōri in Fukushima prefecture was examined in detail with the base map on the scale 1 : 20 000, at the request of the prefectural government. In 1900, an examination of the soil of the Agricultural Experiment Station of Kanagawa prefecture was carried out with special accuracy.

III. TOPOGRAPHICAL SECTION[1]

The field work of the Topographical Section has been so conducted as to be one step in advance of that of the Geological and Agronomical Sections. Out of 99 special maps or sheets, the surveys of 80 have been finished. There have been issued

[1] Refer Pl. III (at the end of this work).

67 sheets, and there are three others in course of preparation or publication, viz. those for Yamaguchi, Hitoyoshi and Sendai.

The reconnaissance maps hitherto published are 5 in number, and those to be undertaken hereafter are of the Divisions VI, VII, and VIII, as mentioned in the account of work in the Geological Section.

The topograghical maps already issued are as follows:—Reconnaissance maps (in Japanese and English): Division I, in 1884; Division II, in 1887; Division III, in 1890; Division IV, in 1892; Division V, in 1894; and Division I (revised), in 1901.

Special Sheets (in Japanese and English): Izu, Yokohama, and Kazusa, in 1884; Tōkyō, Chiba, and Shizuoka, in 1886; Fuji, Kōfu, Maebashi, and Mito, in 1887; Ueda, Nagano, and Nikkō, in 1888; Kitsure-gawa, Toyohashi, Yokkaichi, and Sado, in 1889; Asuke, Nagoya, Toyama, and Ishinomaki, in 1890; Shirakawa, Ogashima, Ōsaka, Aizu, and Ichinoseki, in 1891; Akita, Fukuoka, Noshiro, Miyazu, and Hieizan, in 1892; Ikuno, Toyooka, Kumamoto, Tobishima, and Hamada, in 1893; Tokushima, Akō, Oita, Fukushima, Yahiko, and Okayama, in 1894; Sambeyama, Daisen, Oki, and Kagoshima, in 1895; Honjō, Yoneyama, and Fukui in 1896; Marugame, and Sakata, in 1897; Shibushi, Saga, and Wakayama, in 1898; Miyazaki, Sukumo, and Kōchi, in 1899; Susaki, Uwajima, and Kamaishi, in 1900; Koshikijima, and Tsunoshima, in 1901; Kinomoto, and Nachi, in 1902; Shinjō, Toba, and Sadowara, in 1903.

Topographical map of the Japanese Empire on the scale 1 : 1 000 000 (in Japanese), in 1897. The same in English, in 1899.

Magnetic observations were also carried out over the Main Island (Honshū), Shikoku, and Kyūshū, during the years 1882–83. The numbers of stations at which the Magnetic observations were then made were:—

In the Main Island	....	119
,, ,, Kyūshū ,,	....	30
,, ,, Shikoku ,,	....	17
,, ,, Sado ,,	....	3
Total	....	169

Detailed topographical surveys were carried out in the districts of the Ikuno mine, in 1890; the coal fields in the provinces of Buzen and Chikuzen, in 1890; magnetic observations in the Kamaishi iron mine, in 1891; the district where mineral phosphates are found in the province of Hyūga, in 1895-96; the Obihiro-*hara* in the province of Tokachi, in 1896-98; the coal field in the Hirado peninsula in 1896; the coal fields in the provinces of Buzen and Chikuzen in 1897; the phosphate district in the province of Hyūga, and the oil fields in the province of Echigo, in 1898; the whole area of Kita-aizu-gōri in the province of Iwashiro, and the iron mines in Fukushima and Niigata prefectures, in 1899; the oil field in Yuri-gōri in the province of Ugo, in 1900; the Hōtoku mine in the province of Inaba, in 1901; the coal fields of Amakusa-Shimoshima in the province of Higo, and the iron ore district of Dorogawa in the province of Yamato in 1902; the Chūgoku mine in the province of Bizen, in 1903.

IV. CHEMICAL SECTION

The results of analyses of rocks, minerals and other useful substances sent from the Geological Section, have been included in the explanatory texts accompanying the geological maps, as well as in Bulletins; while those of the analytical investigation and experimental tests conducted in the chemical laboratory, have been made public in special reports. The following are among the more important subjects of investigations and analyses made in this Section: domestic and foreign Portland cements; various raw materials for steel making; bricks, mortars and concretes

(especially, building materials for use in the Yokohama Harbour Works and Tōkyō Water-supply Canal); analyses of more than 300 specimens of magnesian and ordinary limestones; analyses of hundreds of specimens of Japanese ore, coal, coke, petroleum, etc.

OIL LAND SURVEY[1]

In 1876, B. S. LYMAN submitted a proposition to the Minister of the Home Department, respecting the importance of an oil survey for the development of oil fields of Japan. A staff was consequently established, then consisting of fourteen persons, MR. LYMAN being appointed Director. The survey was continued for the following three years, during which some of the oil fields in the Hokkaidō, as well as in Northern and Central Japan, were exlpored.

Although the survey was roughly executed, yet the maps issued on different scales gave some hints to the oil men for the development of the fields. Since that time, the oil industry of Japan remained quiet for a long time, yet steadily progressing. It was indeed about the end of 1899, when the majority of the principal oil men (or oil companies) in Japan, perceiving the importance of a more detailed survey for the development of the oil fields, proposed an petition to the Diet asking that such a survey should be soon carried out by the Government. Accordingly, a staff, consisting of twelve persons with a number of assistants, was newly founded in 1900 as a department of the Imperial Geological Survey, and the work has since been carried on according to a more advanced scheme. In the present plan, the oil fields of Japan are divided into several Sections, according to geographical divisions. A survey of them has been made on the scale of 1 : 10 000 for the general map and on the scale

[1] Refer Pl. IV (at the end of this work).

varying from 1 : 1 000 to 1 : 5 000 for the detailed portions. The Sections which have already been surveyed are as follows:

Sect. I. Higashiyama Oil Field, Echigo
„ II. Southern part of the Akita Oil Field, Ugo
„ III. Nishiyama Oil Field, Echigo
„ IV. Niitsu Oil Field, Echigo
„ V. Kubiki Oil Field, Echigo.

Geological and topographical maps (scale 1 : 20 000) of the first 3 Sections were published with additional maps and descriptive text accompanied by many illustrations; while those of Sections IV and V are to be published in 1904 (fiscal year).

STAFF OF TECHNICAL OFFICIALS
engaged in the Oil Land Survey

	Geologists	Topographers	Chemists	Cartographers	Assistants	Total
1900	3	5		3	6	17
1901	4	7	3	3	9	26
1902	3	7	3	3	13	29
1903	2	4	3	2	10	21

APPENDIX I

ON THE SURVEY OF THE HOKKAIDŌ

The earliest land-survey of Hokkaidō was conducted by Mr. T. Inō, a well known Japanese surveyor. His work was however quite limited in extent. A further systematic survey by Lieutenant Day and others was begun in the year 1874, but unfortunately was not continued more than three years. Finally, in the year 1886, the topographical survey of the Hokkaidō was again taken up. The map of the main island or "Yesso" is divided into 32 sheet-maps or degree-rectangles like those adopted by the Imperial Geological Survey. All these sheets have been completed and are published on the scale of 1 : 200 000.

As regards the geological survey, already in 1862, the mineral resources of the Hokkaidō were investigated by Messrs. P. Blake and R. Pumpelly, American mineralogists and mining engineers in the service of the Tokugawa Government. Their attention was confined to the southern part of the principal island around Hakodate and the Volcano Bay, and the results of their investigations are contained in Pumpelly's "Geological Researches in China, Mongolia and Japan" and Blake's "Reports and Official letters to the *Kaitakushi.*" After an interval of ten years, the geological survey of the Hokkaidō was resumed in the spring of 1873, the work being then carried out under the direction of Mr. B. S. Lyman till the year 1875. With the aid of many assistants, he made special surveys of its coal fields and other mineral districts, and a general exploration chiefly along the sea-board of the largest island and across the central volcanic mountain range, from the Ishikari valley to the mouth of the Tokachi river. The results

of these surveys have all been published in official reports with maps. After MR. LYMAN had left the government service, the work was suspended for about thirteen years. But the geological survey was started again by the Hokkaidō-chō (prefectural office) in 1888, under the direction of MR. K. JIMBŌ as Chief Geologist. The general plan was in full accordance with that adopted by the Imperial Geological Survey. Jimbō and his colleagues were engaged in it from 1888 to 1896. They crossed the main island in different directions and also went as far as the northern extremity of the Chishima group, thus completing the reconnaissance survey of the Hokkaidō.[1]

Recently, various parts of Hokkaidō have occasionally been surveyed by the Imperial Geological Survey. A detailed agronomical survey of the Obihiro-*hara*, in the province of Tokachi was conducted by agronomists of the Imperial Geological Survey, with special regard to colonisation there.

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[1] Refer JIMBŌ's "General geological sketch of Hokkaidō" (in English), and his general map and reports; T. ISHIKAWA and S. YOKOYAMA's "Ore deposits of the Hokkaidō" and "Mineral research in the Hokkaidō" (both in Japanese).

APPENDIX II

ON THE SURVEY OF TAIWAN (FORMOSA)

The geology of Taiwan received but little attention before its incorporation into the Japanese Empire. The works of Gordon, Richthofen, Guppy, Kleinwächter and others are mostly fragmentary and very imperfect. Since the establishment of Sōtoku-Fu" (Japanese Administration Office of Formosa), a Geological Survey has been established in the Department of Industry, under the Bureau of Civil Affairs, and Mr. S. Yokoyama was appointed to execute the work. At the end of the same year, Mr. Y. Ishii was attached to the Survey. In 1896, the number of staff was increased, and the work was placed under the superintendence of Mr. Ishii. In 1897, Mr. Ishii retired from his office, and Mr. K. Inouye occupied the position of the Chief Geologist, but only for one year. Results of the geological surveys by Mr. Ishii appeared in a "Mineralogical and geological map of Taiwan" on the scale 1 : 800 000 with an explanatory text (in Japanese), and in his reports found in memoirs of the Department of Industry; while Mr. Inouye also wrote a report of the mineralogical and geological researches made by him. At the end of 1898, Mr. Inouye resigned his position, and Mr. Y. Saitō was appointed and worked for the subsequent three years. Since the death of Mr. Saitō in 1901 from malaria, the work of the geological survey of Taiwan has been suspended. Mr. Saitō, during his term of service, constructed a topographical reconnaissance map (scale 1 : 400 000), which was published in 1899 by "Sōtoku-Fu." It includes Taiwan and its dependent islands in one sheet, and was a work preliminary to the publication of a geological reconnaissance map. The auriferous

deposits of Zuihō, Kinkwaseki and the Kiirun river, and the coal field of northern Taiwan, and the geology of the Hōko group (Pescadores) were also examined and reported with special accuracy by late Mr. Y. SAITŌ.

The topographical maps (scale 1 : 20 000) published by the War Department were employed as the base of the geological survey, together with auxiliary topographical works executed by the staff of the Survey.

Besides the works of the Geological Survey of Taiwan, "Geology of Dependent isles of Formosa" has been written by Prof. DR. B. KOTŌ, and "Geography of Taiwan and the adjacent Islands" has been compiled and written by MR. T. OGAWA, in which are contained some references to the geology and agronomy of Taiwan.

A

CATALOGUE OF ARTICLES

EXHIBITED BY THE

IMPERIAL GEOLOGICAL SURVEY

OF

JAPAN

AT THE

LOUISIANA PURCHASE EXPOSITION

HELD AT

ST. LOUIS Mo. U. S. A.

1904

A

CATALOGUE OF EXHIBITS

(1) MAPS

Reconnaissance topographical and geological maps (Scale 1:400,000):

Division I,
„ II,
„ III,
„ IV,
„ V.

Special topographical and geological maps (Scale 1:200,000):

Section Kamaishi,
„ Akita,
„ Honjō,
„ Sakata,
„ Fukushima,
„ Fukui,
„ Miyazu,
„ Hieizan,
„ Ōsaka,
„ Wakayama,
„ Ikuno,
„ Tokushima,
„ Oki,
„ Okayama,
„ Marugame,
„ Kōchi,
„ Uwajima,
„ Oita,
„ Miyazaki,
„ Fukuoka,
„ Saga,

Section Kumamoto,
„ Kagoshima,
„ Koshikijima.

Topographical map of the Japanese Empire (Scale 1 : 1,000,000),
Geological „ „ „ „ „ („ „),
General map showing orography of the Japanese Empire and depths of the surrounding ocean bottoms (Scale 1 : 2,500,000),
Agronomical maps (Scale 1 : 100,000 ; in Japanese and English):
Musashi province (northern part),
Sagami „ and the southern part of Musashi province,
Owari and Mikawa provinces,
Kawachi and Izumi „ and the eastern part of Settsu „ ,
General agronomical map of the Japanese Empire (Scale 1 : 500,000 ; in Japanese and English) in two parts, with the table showing distribution of the cultivable and cultivated lands.
General map of known oil and gas field of the Japanese Empire (Scale 1 : 000,000),
Geological and topographical maps of the oil field of Japan (Scale 1 : 20,000 ; in Japanese and English):
Section I, Higashiyama oil field, Echigo (with profiles),
„ II, The southern part of Minami-Akitagōri, Ugo (with profiles),
„ III, Nishiyama oil field, Echigo (with profiles, detailed maps, etc.)
Reliefs of the Volcano Bandai,[1] before and after its eruption 1886, (horizontal scale 1 : 50,000 ; vertical scale 1 : 25,000), with the reference map (scale 1 : 50,000).

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(2) EXPLANATORY TEXTS, BULLETINS, REPORTS, ETC.

Explanatory text to the special geological map of the
Section Kamaishi, (in Japanese)
„ Akita, „

[1] The reliefs are made of genuine Japanese papers after gypsum models.

Section	Honjō,	(in Japanese)
„	Sakata,	„
„	Fukushima,	„
„	Fukui,	„
„	Miyazu,	„
„	Hieizan,	„
„	Ōsaka,	„
„	Wakayama,	„
„	Ikuno,	„
„	Tokushima,	„
„	Oki,	„
„	Okayama,	„
„	Marugame,	„
„	Kōchi,	„
„	Uwajima,	„
„	Oita,	„
„	Miyazaki,	„
„	Fukuoka,	„
„	Saga,	„
„	Kumamoto,	„
„	Kagoshima,	„
„	Koshikijima,	„

Explanatory text to the agronomical map of the

Musashi province (northern part), (in Japanese)

Sagami province and the southern part of Musashi province, (in Japanese)

Owari and Mikawa provinces, (in Japanese)

Kawachi and Izumi „ and the eastern part of Settsu province, (in Japanese).

Explanatory text to the geological and topographical map of the oil field of Japan,

Section I, Higashiyama oil field, Echigo (in Japanese),

„ II, The southern part of Minami-Akitagōri, Ugo (in Japanese),

Bulletins of the Imperial Geological Survey of Japan, Vols. IX-XVI (in Japanese),

Report on the geology of Ikuno Mine (with maps), (in Japanese)

Outlines of the geology of Japan (descriptive text to accompany the geological map of the Japanese Empire on the scale 1:1,000,000),

Beiträge zur Kenntniss der japanischen Landwirthschaft.
Von Prof. Dr. M. FESCA. I. Allgemeiner Theil.
II. Specieller „

Photographic portraits of the personnel of the Imperial Geological Survey of Japan.

(3) MINERALS

The specimens, here exhibited, are a portion of Mr. T. WADA'S collection which contains the most complete and finest specimens of Japanese minerals. They include nearly all the mineral species so far as found in Japan, and are classified according to P. GROTH'S system with their corresponding localities as follows:

I. ELEMENTS

No.	Name	Locality
1.	Graphite	*Kawai, Hida.*
2.	Native Sulphur	*Yonago, Shinano.*
3.	„ „	*Shirane, Kōzuke.*
4.	Native Arsenic	*Akatani, Echizen.*
5.	„ „ in Liparite	„ „
6.	Native Bismuth	*Ikuno, Tajima.*
7.	Native Platinum	*Yūbarigawa, Ishikari.*
8.	Iridosmine	„ „
9.	Native Copper	*Osaruzawa, Rikuchū.*
10.	„ „ in Slate	*Makimine, Hyūga.*
11.	Native Silver in Quartz Geode	*Innai, Ugo.*
12.	Native Silver on Argentiferous Quartz Vein	*Ikuno, Tajima.*
13.	Native Mercury in Sandstone	*Minato, Hyuga.*
14.	Gold Nugget	*Ezashi, Kitami.*

No.	Name	Locality
15.	**Native Gold on Quartz**	*Yamagano, Ōsumi.*
16.	„ „ „ „	*Zuihō, Taiwan (Formosa).*

II. COMPOUNDS OF SULPHUR, SELENIUM, TELLURIUM, ARSENIC, ANTIMONY AND BISMUTH

17.	**Realgar**	*Monji, Rikuzen.*
18.	**Orpiment**	*Osorezan, Mutsu.*
19.	**Stibnite**	*Ichinokawa, Iyo.*
20.	„	„ „
21.	„	„ „
22.	„	„ „
23.	**Bismuthinite in Calco-quartzose Vein**	*Sannotake, Buzen.*
24.	**Molybdenite**	*Shirakawa, Hida.*
25.	„	*Kawachi, Echigo.*
26.	**Blende with Calcite on Rock Crystal Aggregate**	*Ani, Ugo.*
27.	**Blende**	*Shiraita, Echigo.*
28.	„ **with Rhodochrosite**	*Saimyōji, Ugo.*
29.	**Pyrrhotine**	*Yoshioka, Bitchu.*
30.	**Pyrites**	*Osaruzawa, Rikuchū.*
31.	„	*Udo, Izumo.*
32.	„	*Sagi, Izumo.*
33.	„	*Ani, Ugo.*
34.	„	*Akadani, Echigo.*
35.	**Marcasite**	*Ani, Ugo.*
36.	„	*Osaruzawa, Rikuchu.*
37.	**Arsenopyrite**	*Furigusa, Mikawa.*
38.	**Galena and Chalcopyrite on Rock Crystal Aggregate**	*Ani, Ugo.*
39.	**Galena and Rhodochrosite on Breccia**	*Kuratani, Kaga.*
40.	**Galena with Chalcopyrite and Calcite**	*Daira, Ugo.*

No.	Name	Locality
41.	Argentite in Rock Crystal Druse	*Ikuno, Tajima.*
42.	Argentite in Rock Crystal Druse	*Aikawa, Sado.*
43.	Chalcosine	*Omodani, Echizen.*
44.	Petzite in Quartz Vein (Telluric Gold)	*Setamai, Rikuzen.*
45.	Cinnabar	*Komagaeri, Yamato.*
46.	„ in Calcite	*Suii, Awa (Shikoku).*
47.	Cinnabar	*Ōkuchi, Satsuma.*
48.	Bornite	*Ikuno, Tajima.*
49.	Chalcopyrite	*Ani, Ugo.*
50.	„ with Rock Crystal Aggregates	*Kuriyama, Shimotsuke.*
51.	Chalcopyrite in Rock Crystal Aggregates	*Arakawa, Ugo.*
52.	Chalcopyrite with Rock Crystal Aggregates	„ „
53.	Matildite in Quartz Vein	*Kuriyama, Shimotsuke.*
54.	Jamesonite.	*Innai, Ugo.*
55.	Pyrargyrite in Quartz Vein	„ „
56.	Tetrahedrite on Rock Crystal Aggregates	*Kiura, Bungo.*
57.	Stephanite in Rock Crystal Geodes with Pyrites	*Innai, Ugo.*
58.	Stephanite	„ „
59.	Stannite on Chalcopyrite	*Ikuno, Tajima.*

III. OXYGEN-COMPOUNDS OF ELEMENTS

60.	Rock Crystal	*Otomezaka, Kai.*
61.	„ „	„ „
62.	„ „	„ „
63.	„ „	„ „
64.	„ „	*Tanabe, Kii.*
65.	„ „	*Narushima, Hizen.*
66.	„ „	*Tashiro, Mino.*

No.	Name	Locality
67.	**Rock Crystal with Actinolite Enclosures, (Prase)**	*Takemori, Kai.*
68.	**Rock Crystal**	*Kimpuzan, „*
69.	**Smoky Quartz**	*Naegi, Mino.*
70.	„ „	*Takayama, „*
71.	„ „	*Tanokamiyama, Omi.*
72.	„ „	„ „
73.	**Amethyst**	*Obara, Iwaki.*
74.	**Rose Quartz**	*Tozawa, „*
75.	**Ferruginous Quartz**	*Hanawa, Rikuchu.*
76.	**Chalcedony**	*Aikawa, Sado.*
77.	„	*Natani, Kaga.*
78.	„	*Oguni, Uzen.*
79.	**Tridymite**	*Ishigamiyama, Higo.*
80.	**Rutile**	*Takayama, Mino.*
81.	**Cassiterite on Sandstone**	*Takano, Hitachi.*
82.	**Cassiterite (Stream Tin)**	*Takayama, Mino.*
83.	**Pyrolusite**	*Nisembets, Shiribeshi.*
84.	**Sapphire**	*Takayama, Mino.*
85.	**Hematite (Specular Iron)**	*Sennin, Rikuchu.*
86.	**Cuprite**	*Nishi-tada, Settsu.*
87.	**Chalcotrichite on Malachite**	*Arakawa, Ugo.*
88.	**Tenorite**	*Kosaka, Rikuchu.*
89.	**Opal**	*Tsuno, Buzen.*
90.	„	*Natani, Kaga.*
91.	**Hyalite**	*Tateyama, Etchu.*
92.	„	„ „
93.	**Siliceous Sinter**	„ „
94.	**Manganite**	*Owani, Mutsu.*
95.	**Limonite**	*Kotaki, Ugo.*

IV. HALOID SALTS

96.	**Horn Silver on Manganese Ore**	*Tsubaki, Ugo.*
97.	**Fluorite**	*Obira, Bungo.*
98.	„	*Ikuno, Tajima.*

V. CARBONATES, MANGANITE AND PLUMBATE

No.	Name	Locality
99.	**Iceland Spar**	*Ōdaki, Musashi.*
100.	**Calcite**	*Furokura, Rikuchū.*
101.	,,	*Osaruzawa,* ,,
102.	,,	*Ani, Ugo.*
103.	,,	*Maze, Echigo.*
104.	**Calc Sinter**	*Kawachi, Hitachi.*
105.	**Dolomite**	*Innai, Ugo.*
106.	**Magnesite**	*Kuratani, Kaga.*
107.	**Smithonite**	*Kamioka, Hida.*
108.	**Rhodochrosite**	*Saimyōji, Ugo.*
109.	,,	*Kuratani, Kaga.*
110.	**Siderite**	*Uchinokuchi, Bungo.*
111.	,,	*Omori, Iwami.*
112.	**Witherite**	*Tsubaki, Ugo.*
113.	**Aragonite**	*Takasegawa, Shinano.*
114.	**Cerussite on Quartz**	*Kisanmori, Ugo.*
115.	**Cerussite**	*Arakawa,* ,,
116.	**Malachite**	*Hisan-ichi,* ,,
117.	,,	*Ani,* ,,
118.	**Azurite**	*Higoshi, Bitchū.*
119.	**Psilomelane**	*Numadate, Ugo.*
120.	**Asbolite**	*Seto, Owari.*

VI. SULPHATES, MOLYBDATE AND WOLFRAMATES

121.	**Barytes with Jamesonite Enclosures**	*Kuratani, Kaga.*
122.	**Barytes**	*Tsubaki, Ugo.*
123.	,,	*Aikawa, Sado.*
124.	,,	*Osaruzawa, Rikuchū.*
125.	**Wulfenite**	*Kami-Wakōgo, Echizen.*
126.	**Scheelite**	*Kamikane, Kai.*
127.	,, **in Argentiferous Quartz Vein**	*Sannotake, Buzen.*

No.	Name	Locality
128.	**Scheelite in Argentiferous Quartz Vein**	*Ikuno, Tajima.*
129.	**Reinite**	*Otomezaka, Kai.*
130.	**Wolframite**	*Takayama, Mino.*
131.	**Ferberite in Quartz**	*Kurasawa, Kai.*
132.	**Alunite**	*Tochihara, Harima.*
133.	**Linarite**	*Arakawa, Ugo.*
134.	**Gypsum**	*Yagosawa, Kai.*

VII. FERRITES

135.	**Chromite**	*Yakeyama, Chikuzen.*
136.	**" in Serpentine**	*Mukawa, Iburi.*
137.	**Magnetite**	*Kamaishi, Rikuchu.*
138.	**" in Quartzite**	*Ogushi, Hizen.*

VIII. PHOSPHATES, ARSENATES, NIOBATES AND TANTALATES

139.	**Fergusonite**	*Takayama, Mino.*
140.	**Columbite**	*Yamanoo, Hitachi.*
141.	**Apatite**	*Miyamoto, Kai.*
142.	**"**	*Ashio, Shimotsuke.*
143.	**"**	*Kurokura, Sagami.*
144.	**Pyromorphite on Quartz-porphyry**	*Kamioka, Hida.*
145.	**Libethenite on Rock Crystal Aggregates**	*Arakawa, Ugo.*
146.	**Vivianite in Clay**	*Kimpōzan, Higo.*
147.	**Vivianite**	*Ashio, Shimotsuke.*
148.	**Scorodite**	*Kiura, Bungo.*

IX. SILICATES AND TITANATES

149.	**Hemimorphite**	*Kiura, Bungo.*
150.	**Andalusite in Pegmatite**	*Ishikawa, Iwaki.*
151.	**Topaz in Intergrowth with Smoky Quartz**	*Tanokamiyama, Omi.*

No.	Name	Locality
152.	Topaz	*Tanokamiyama, Omi.*
153.	„	„ „
154.	„	*Takayama, Mino.*
155.	„	„ „
156.	„	„ „
157.	„	„ „
158.	„	*Naegi, Mino.*
159.	Datolite with Axinite	*Yamaura, Hyuga.*
160.	„ „ „	„ „
161.	Tourmaline	*Takayama, Mino.*
192.	„	*Ishikawayama, Iwaki.*
163.	„	„ „
164.	„	*Goshodaira, Shinano.*
165.	Lievrite	*Zōmeki, Nagato.*
166.	„	*Kamioka, Hida.*
167.	Epidote	*Takeshi, Shinano.*
168.	„	*Kamaishi, Rikuchū.*
169.	Vesuvianite	*Kiura, Bungo.*
170.	„	„ „
171.	Danburite	*Obira,* „
172.	„	„ „
173.	Garnet	*Arimine, Etchū.*
174.	„	*Shimohogi, Nagato.*
175.	„ in Druse with Diopside and Quartz	*Kamaishi, Rikuchū.*
176.	Garnet	*Ishikawayama, Iwaki.*
177.	„	*Yamanoo, Hitachi.*
178.	„ in Pegmatite	*Ishikawayama, Iwaki.*
179.	Axinite	*Obira, Bungo.*
180.	„	*Yamaura, Hyūga.*
181.	„	*Obira, Bungo.*
182.	„	„ „
183.	Biotite	*Miyamoto, Kai.*
184.	Zinnwaldite	*Tanokamiyama, Omi.*
185.	Muscovite and Smoky Quartz in Orthoclase	„ „
186.	Muscovite	„ „

No.	Name	Locality
187.	**Chlorite as Druse in Magnetite**	*Kamaishi, Rikuchū.*
188.	**Talc**	*Ōgushi, Hizen.*
189.	**Cordierite in Volcanic Ejecta**	*Asamayama, Shinano.*
190.	**Pinite after Cordierite**	*Dōshi, Kai.*
191.	**Diopside and Epidote in Druse**	*Kamaishi, Rikuchū.*
192.	**Hedenbergite**	*Obira, Bungo.*
193.	„	„ „
194.	**Augite**	*Tateshinayama, Shinano.*
195.	„	*Kami-Sano, Kai.*
196.	**Wollastonite**	*Komiyagami, Mino.*
197.	**Rhodonite**	*Innai, Ugo.*
198.	„	*Oyamada, Mikawa.*
199.	**Actinolite**	*Gorōtsuyama, Iyo.*
200.	„	„ „
201.	**Hornblende**	*Hiyoshi, Bitchū.*
202.	„	*Hakusan, Kaga.*
203.	„	*Kiirun, Taiwan (Formosa).*
204.	**Beryl**	*Ishikawayama, Iwaki.*
205.	„	*Tanokamiyama, Ōmi.*
206.	„	„ „
207.	**Orthoclase**	*Miyamoto, Kai.*
208.	„	*Tanokamiyama, Ōmi.*
209.	„ **with Smoky Quartz**	„ „
210.	**Orthoclase**	„ „
211.	„	„ „
212.	„	„ „
213.	„ **with Smoky Quartz**	*Naegi, Mino.*
214.	**Amazonstone**	*Miyamoto, Kai.*
215.	**Andesine**	*Shioda, Shinano.*
216.	„	*Iwōjima (Volcano Islands).*
217.	**Anorthite**	*Miyakejima, Izu.*
218.	**Titanite in Diorite**	*Kamioka, Hida.*
219.	**Apophyllite in Druse in Tuff**	*Maze, Echigo.*
220.	**Apophyllite**	„ „

No.	Name	Locality
221.	Apophyllite and Analcime in Druse in Tuff	*Maze, Echigo.*
222.	Chabasite	*Hishikari, Satsuma.*
223.	Analcime	*Maze, Echigo.*
224.	Heulandite	*Ogasawarajima (Bonin Islands).*

SPECIMENS OF LARGE SIZE

648.	Apatite and Rock Crystal on Copper Ore	*Ashio, Shimotsuke.*
649.	Stibnite	*Ichinokawa, Iyo.*
650.	"	" "
651.	Topaz	*Takayama, Mino.*
652.	Stibnite	*Ichinokawa, Iyo.*
653.	"	" "
654.	Rock Crystal	*Kurasawa, Kai.*
655.	" "	" "
656.	" "	*Takemori,* "
657.	Calcite, Blende and Chalcopyrite	*Ani, Ugo.*
658.	Alabandine	*Saimyōji, Ugo.*
659.	Quartz after Barytes	*Arakawa,* "
660.	Danburite and Garnet	*Obira, Bungo.*
661.	Rhodochrosite, Blende and Pyrites	*Kuratani, Kaga.*
662.	Apophyllite and Analcime	*Maze, Echigo.*
663.	Calcite	*Innai, Ugo.*
664.	Rock Crystal and Stibnite	*Ichinokawa, Iyo.*
665.	Galena with Pyrites, Calcite and Quartz	*Daira, Ugo.*
666.	Reinite	*Otomezaka, Kai.*
667.	Rock Crystal	*Kurasawa, Kai.*
668.	Axinite	*Obira, Bungo.*

(4) ROCKS

The specimens of rocks, here exhibited, include most of the typical ones found in Japan. They are arranged according to their geological formations with their corresponding localities as follows:

A. METAMORPHIC ROCKS

I. GNEISS

No.	Name	Locality
225.	**Granitic Gneiss**	***Shimotsukawa, Iwaki.***
226.	„ „	***Kami-Kōchi, Hitachi.***
227.	**Augen-gneiss**	***Shioda, Awaji.***
228.	**Porphyritic Gneiss**	***Takatō, Shinano.***
229.	**Biotite-gneiss**	***Kamada, Iwaki.***
230.	**Muscovite-gneiss**	***Hase, Hitachi.***
231.	**Mica-schist**	***Shimo-matsukawa, Iwaki.***
232.	„ **with Andalusite**	***Hase, Hitachi.***
233.	**Mica-schist**	***Misakubo, Tōtōmi.***
234.	**Crystalline Limestone**	***Takanuki, Iwaki.***
235.	**Cipoline**	***Kambaratōge, Hida.***
236.	**Amphibolite**	***Tamadare, Hitachi.***
237.	**Amphibole-gneiss**	„ „
238.	**Amphibole-schist**	***Ishizumi, Iwaki.***
239.	**Quartzite**	„ „

II. CRYSTALLINE SCHIST

240.	**Sericite-schist**	***Tokushima, Awa (Shikoku).***
241.	„	***Sueno, Musashi.***
242.	„	***Ōboke, Awa (Shikoku).***
243.	**Piedmontite-schist**	***Tokushima,*** „
244.	„	***Minano, Musashi.***
245.	**Piedmontite-quartzite**	***Tokushima, Awa (Shikoku).***
246.	**Glaucophane-sericite-schist**	„ „
247.	„	„ „

No.	Name	Locality
248.	Porphyritic Sericite-gneiss	*Mie, Hizen.*
249.	„ „	„ „
250.	Spotted Graphite-schist	*Yanaze, Musashi.*
251.	„ „	*Mie, Hizen.*
252.	Graphite-schist	„ „
253.	„	*Yamashirodani, Awa (Shikoku).*
254.	Spotted Chlorite-amphibolite	*Tokushima, Awa (Shikoku).*
255.	„ „	*Yanaze, Musashi.*

B. SEDIMENTARY ROCKS

I. PALÆOZOIC

256.	Amphibolite	*Mihara, Kōzuke.*
257.	„	*Negishi, Iwaki.*
258.	Pyroxenite	*Sakahara, Kōzuke.*
259.	Crystalline Limestone	*Mayumi, Hitachi.*
260.	„ „	*Yuzurihara, Kōzuke.*
261.	Adinole Slate	*Mamba,* „
262.	„	*Hibara,* „
263.	Quartzite	*Heibara,* „
264.	Schalstein	*Kodaira,* „
265.	Radiolarian Slate	*Shitsumi, Wakasa.*
266.	Limestone	*Kuroda, Kōzuke.*
267.	Schalstein	*Kashiwagi,* „
268.	„	*Kodaira,* „
269.	„	*Mane, Musashi.*
270.	„	*Takōzu, Rikuchū.*
271.	Greywacke Sandstone	*Kagahara, Kōzuke.*
272.	Hornstone	*Yonō,* „
273.	Limestone	*Kagahara,* „
274.	Schwagerina Limestone	*Akasaka, Mino.*
275.	Brecciated Limestone	„ „
276.	Metamorphosed Limestone with Augite (Sahlite)	*Okazakiyama, Yamashirō.*
277.	Clay-slate	*Ashio, Shimotsuke.*

No.	Name	Locality
278.	**Ottrelite-slate**	*Miyata, Hitachi.*
279.	**Mica-slate**	*Yamaguchi,* ,,
280.	**Hornstone (Metamorphosed)**	*Nyoidake, Yamashiro.*
281.	**Andalusite-slate**	*Shirasu, Yamashiro.*
282.	**Cordierite-slate**	*Okazakiyama,* ,,
283.	,,	*Shirasu, Yamashiro.*
284.	**Micaceous Sandstone**	*Wayama, Rikuchu.*

II. MESOZOIC

285.	**Shale**	*Innai, Rikuzen.*
286.	**Clay-slate**	*Ogachibama,* ,,
287.	**Shale with Daonella**	*Sakawa, Tosa.*
288.	**Schalstein with Pentacrinus**	*Aohama, Buzen.*
289.	**Schalstein**	*Morihiro, Nagato.*
290.	**Conglomerate**	*Onami, Tango.*
291.	,,	*Yamanoi, Nagato.*
292.	,,	*Todai, Shinano.*
293.	**Trigonia Sandstone**	*Kurokawachi,* ,,
294.	**Sandstone**	*Minato, Awaji.*
295.	,,	,, ,,
296.	**Sandy Shale**	*Miura, Iyo.*
297.	**Siliceous Limestone with Foraminifera**	*Setonoya, Suruga.*

III. CAINOZOIC

1. *Tertiary*

298.	**Marly Limestone**	*Isomura, Awa (Honshū).*
299.	**Limestone**	*Fukaya, Noto.*
300.	**Calcareous Sandstone**	*Nanatsugama, Hizen.*
301.	**Conglomerate**	*Iida, Musashi.*
302.	**Sandstone**	*Itsukaichi,* ,,
303.	,,	*Miike, Chikugo.*
304.	,,	*Shibuya, Etchū.*
305.	**Shell Conglomerate**	*Mōrai, Ishikari.*

No.	Name	Locality
306.	**Shale with Fossil Shells**	*Yumoto, Iwaki.*
307.	**Calcareous Tuff**	*Kaisuka, Awa (Honshū).*
308.	**Tuff Breccia**	*Iwatsu, Tajima.*
309.	**Tuff**	*Yumoto, Sagami.*
310.	„	*Uraga,* „

2. *Quaternary*

311.	**Loam**	*Shibuya, Musashi.*
312.	**Sand**	„ „
313.	**Gravel**	„ „

C. ERUPTIVE ROCKS

I. PALÆO-ERUPTIVE ROCKS

314.	**Granite**	*Oda, Hitachi.*
315.	**Granitite**	*Sumoto, Awaji.*
316.	**Hornblende-granitite**	*Ashio, Shimotsuke.*
317.	„	*Kanayama, Tango.*
318.	„	*Kurita,* „
319.	**Porphyritic Granitite**	„ „
320.	„ „	*Kamigori, Hitachi.*
321.	**Granite with Allanite**	*Jōdojimachi, Yamashiro.*
322.	**Aplite**	*Maezawa, Kai.*
323.	**Graphic Granite**	*Ishikawayama, Iwaki.*
324.	**Corsite**	*Shiroishi,* „
325.	**Mica-diorite**	*Yunotake,* „
326.	**Quartz-diorite**	*Ishigoyama, Awa (Honshū).*
327.	**Gabbro-diorite**	*Mineokayama,* „
328.	**Gabbro**	„ „
329.	**Norite**	*Shioda, Awaji.*
330.	**Peridotite**	*Saimaru, Hitachi.*
331.	„	*Ono, Higo.*
332.	„	*Machiya, Hitachi.*
333.	„	„ „
334.	„	„ „

No.	Name	Locality
335.	**Ophicalcite**	*Kanasaki, Musashi.*
336.	„	*Kurokōchi, Shinano.*
337.	**Quartz-porphyry**	*Kukuno, Hida.*
338.	**Hornblende-porphyrite**	*Yunotake, Iwaki.*
339.	**Diabase**	*Maue, Musashi.*
340.	**Augite-porphyrite**	*Kebaraichi, Rikuchū.*
341.	„	*Kanazawa,* „
342.	„	*Misaka, Kai.*
343.	„	*Hōzugawa, Tamba.*
344.	**Fourchite**	„ „

II. NEO-ERUPTIVE ROCKS

345.	**Liparite**	*Shirane, Shimotsuke.*
346.	„	*Ashio,* „
347.	**Rhyolite**	*Otagiri, Shinano.*
348.	**Piedmontite-rhyolite**	*Karuizawashinden, Shinano.*
349.	**Perlite**	*Kurogamiyama, Hizen.*
350.	„	*Hōraijiyama, Mikawa.*
351.	**Pumice**	*Toshima, Izu.*
352.	**Trachyte**	*Tsuruha, Sanuki.*
353.	**Dacite**	*Kumasaka, Izu.*
354.	**Mica-andesite**	*Yurayama, Sanuki.*
355.	„ **with Garnet**	*Anamushi, Yamato.*
356.	**Hornblende-andesite (Haruna Lava)**	*Ikaho, Kōzuke.*
357.	**Hornblende-andesite (Haruna Lava)**	*Harunafuji,* „
358.	**Hornblende-andesite (Shirane Lava)**	*Shirane, Shimotsuke.*
359.	**Hornblende-andesite**	*Hidake, Higo.*
360.	„	*Aonoyama, Iwami.*
361.	„ **(Hakusan Lava)**	*Hakusan, Kaga.*
362.	**Andesite-Obsidian**	*Ikadaba, Izu.*
363.	**Obsidian**	*Wadatōge, Shinano.*
364.	**Spherulitic Obsidian**	*Yugashima, Izu.*
365.	**Propylite**	*Ikuno, Tajima.*

No.	Name	Locality
366.	Propylite	*Yugashima, Izu.*
367.	"	*Yaguradake, Sagami.*
368.	Pyroxene-andesite (Iwaki Lava)	*Iwakisan, Mutsu.*
369.	Two-pyroxene-andesite	*Kanehira,* "
370.	" (Chōkai Lava)	*Chōkaisan, Uzen.*
371.	Olivine-pyroxene-andesite (Iwate Lava)	*Iwatesan, Rikuchū.*
372.	Two-pyroxene-andesite (Zaō Lava)	*Zaōsan, Rikuzen.*
373.	Two-pyroxene-andesite (Bandai Lava)	*Bandaisan, Iwashiro.*
374.	Olivine-pyroxene-andesite (Nasu Lava)	*Nasusan, Shimotsuke.*
375.	Augite-andesite (Asama Lava)	*Asamayama, Shinano.*
376.	Cordierite-bearing Ejecta (Rhyolite)	" "
377.	Pyroxene-andesite (Nantai-san Lava)	*Chūzenji, Shimotsuke.*
378.	Pyroxene-andesite (Yatsu-gatake Lava)	*Ochiai, Shinano.*
379.	Pyroxene-andesite	*Komekami, Sagami.*
380.	Two-pyroxene-andesite	*Tōnosawa,* "
381.	Pyroxene-andesite (Amagi Lava)	*Jizōdō, Izu.*
382.	Pyroxene-andesite	*Togi, Noto.*
383.	Mica-pyroxene-andesite (Daisen Lava)	*Daisen, Hōki.*
384.	Pyroxene-andesite (Aso Lava)	*Tochiki, Higo.*
385.	Pyroxene-andesite (Aso Lava)	*Aso-Nakadake, Higo.*
386.	Pyroxene-andesite	*Kagoshima, Satsuma.*
387.	" (Otake Lava)	*Sakurajima,* "
388.	Sanukite	*Kokubu, Sanuki.*
389.	Enstatite-andesite	*Chōshi, Shimōsa.*

No.	Name	Locality
390.	**Boninite**	*Ogasawarajima (Bonin Islands).*
391.	**Plagioclase-basalt (Fuji Lava)**	*Fujisan, Suruga.*
392.	**Bomb**	,, ,,
393.	**Ropy Lava**	*Tainaikuguri, Kai.*
394.	**Phanerocrystalline Bomb, covered with Black Lava**	*Fujisan, Suruga.*
395.	**Basalt**	*Gembudō, Tajima.*
396.	,,	*Wadatōge, Shinano.*
397.	,,	*Ōmurosan, Izu.*
398(**a**).	,,	*Daikonjima, Izumo.*
,, (**b**).	,,	*Ōgusoyama, Iwami.*

(5) FOSSILS

The following are some of the characteristic fossils hitherto found in Japan, and represent the Japanese types of fossils embedded in the strata, ranging from the Carboniferous to the Tertiary. They are arranged according to their geological ages with their corresponding localities:

I. PALÆOZOIC

Carboniferous

No.	Name	Locality
399.	**Fusulina japonica** *Gümb.*	*Akasaka, Mino.*
400.	**Schwagerina Verbeeki** *Geinitz*	,, ,,
401.	**Lonsdaleia Akasakaensis** *Yabe*	,, ,,
402.	**Lithostrotion sp.**	*Tsukitate, Rikuzen.*
403.	**Campophyllum sp.**	*Sennin.* ,,

No.	Name	Locality
404.	**Productus sp.**	*Setamai, Rikuzen.*
405.	**Bellerophon sp.**	*Akasaka, Mino.*
406.	**a. Chemnitzia sp.** / **b. Murchisonia sp.**	" "
407.	**Trilobite (Phillipsia sp).**	*Arisu, Rikuzen.*

II. MESOZOIC

1. *Triassic*

408.	**Pseudomonotis ochotica** (*Keyserl.*) *Teller*	*Nariwa, Bitchū.*
409.	**Daonella Kotoi** *E. v. Mojs.*	*Sakawa, Tosa.*
410.	**Ceratites sakawanus** *E. v. Mojs.*	" "
411.	**Arpadites (Anorcites) Gottschei** *E. v. Mojs.*	*Inai, Rikuzen.*
412.	**Dictyophyllum japonicum** *Yok.*	*Yamanoi, Nagato.*
413.	**Baiera cf. paucipartela** *Nath.*	" "
414.	**Asplenium Rösserti** *Presl.*	" "

2. *Jurassic*

415.	**Cyclolites sp.**	*Higashinagano, Nagato.*
416.	**Trigonia V-costata** *Lyc.*	*Hosoura, Rikuchū.*
417.	**Harpoceras sp.**	*Nishi-nakayama, Nagato.*
418.	**Perisphinctes sp.**	*Nagano, Echizen.*
419.	**Onychiopsis elongata** *Geyl.*	*Yanagidani, Kaga.*
420.	**Asplenium argutulum** *Hr.*	*Shima, Kaga.*
421.	**Nilssonia nipponensis** *Yok.*	*Okamigō, Hida.*
422.	**Podozamites Reinii** *Geyl.*	" "
423.	**Gingko digitata** *Brgt.*	" "
424.	**Gingkodium Nathorsti** *Yok.*	*Shima, Kaga.*
425.	**Pecopteris exilis** *Phill.*	" "
426.	**Dioonites Kotoei** *Yok.*	*Tani, Echizen.*

No.	Name	Locality
427.	a. **Asplenium whitbiense** *Brgt.* b. **Nilssonia ozoana** *Yok.* c. **Taeniopteris sp.**	***Ozō, Kaga.***

3. *Cretaceous*

No.	Name	Locality
428.	**Thamnastraea sp.**	***Shiraishi, Tosa.***
429.	**Pygurus asiaticus** *Yosh.*	***Torinosu,*** „
430.	**Avicula Haradae** *Yok.*	***Kagahara, Kōzuke.***
431.	**Trigonia pocilliformis** *Yok.*	„ „
432.	„ „ „	***Tanono, Awa (Shikoku).***
433.	**Nerinea cf. Visurgis** *Römer*	***Sakawa, Tosa.***
434.	**Desmoceras Damesi** *Jimbō*	***Abeshinai, Teshio.***
435.	**Puzosia planulatiforme** „	„ „
436.	**Pachydiscus Haradai** „	„ „
437.	**Pachydiscus sp.**	***Kagahara, Kōzuke.***
438.	**Tetragonites sphaeronotus** *Jimbō*	***Yubarigawa, Ishikari.***
439.	a. **Gaudryceras limatum** *Yabe* b. **Scaphites puerculus** *Jimbō*	***Abeshinai, Teshio.***
440.	**Anisoceras Haradanum** *Yok.*	„ „
441.	**Anisoceras sp. (aff. A. indicum** *Forb.*)	***Kagahara, Kōzuke.***
442.	**Hamites yubarensis** *Yabe*	***Yūbari, Ishikari.***
443.	**Inoceramus Naumanni** *Yok.*	***Urakawa, Hidaka.***
444.	**Pecopteris Geyleriana** *Nath.*	***Sakawa, Tosa.***
445.	**Zamiophyllum Buchianum** *Ett.*	„ „

III. CAINOZOIC

1. *Tertiary*

No.	Name	Locality
446.	**Nummulite javanus** *Verbeek*	***Ogasawarajima (Bonin Islands).***

No.	Name	Locality
447.	**Schizaster nummuliticus** *Yosh.*	***Ogasawarajima (Bonin Islands).***
448.	**Linthia nipponica** *Yosh.*	***Miyata, Hitachi.***
449.	**Dendrophyllia sp.**	***Kushimoto, Kii.***
450.	**Pentacrinus Stem.**	„ „
451.	**Rhynchonella psittacea** *Gmel.*	***Miyata, Hitachi.***
452.	**Pecten laetus** *Gould*	***Ose, Hitachi.***
453.	**Mytilus grayanus** *Dunk.*	***Nippaomanai, Hidaka.***
454.	**Panopaea generosa** *Gould*	***Ioki, Tosa.***
455.	**Conchocele disjuncta** *Gabb.*	***Mōrai, Ishikari.***
456.	**Clavagella sp.**	***Tōnohama, Tosa.***
457.	**Vicarya callosa** *Martens*	***Tsukiyoshi, Mino.***
458.	**Brachyura sp.**	***Suenomatsuyama, Mutsu.***
459.	**Oxyrhina sp.**	***Shimoda, Izu.***
460.	**Leuciscus n. sp.**	***Yawataura, Iki.***
461.	**Lithothamnium sp.**	***Ogasawarajima (Bonin Islands).***
462.	**Myriophyllum n. sp.**	***Shiobara, Kōzuke.***
463.	**Carpiniphyllum pyramidale** *Göp.* **sp. japonicum** *Nath.*	***Asano, Shinano.***
464.	**Trapa n. sp.**	***Ogoya, Kaga.***
465.	**Acer palmatum** *Th.*	***Shiobara, Shimotsuke.***

SPECIMENS OF LARGE SIZE

466.	**Subcarboniferous Fossils in Limestone**	***Akasaka, Mino.***
467.	**Bellerophon sp.**	„ „
468.	**Pleurotomaria sp.**	„ „
469.	**Gymnites Watanabei** *E. v. Mojs.*	***Inai, Rikuzen.***
470.	**Arpadites (Clinites) Naumanni** *E. v. Mojs.*	„ „

No.	Name	Locality
471.	**Dioonites Kotoei** *Yok.* **Anomozamites sp.**	*Shima, Kaga.*
472.	**Gingkodium Nathorsti** *Yok.*	„ „
473.	**Pachydiscus Naumanni** „	*Urakawa, Hidaka.*
474.	a. **Zamiophyllum Buchianum** *Ett.* **sp.** b. **Nilssonia pterophylloides** *Yok.* c. **Chladophlebis Nathorsti** *Yok.*	*Ryōseki, Tosa.*
475.	**Conchocele disjuncta** *Gabb.*	*Iruma, Iwashiro.*
476.	**Cyprina sp.**	*Kosaji, Omi.*
477.	**Stegodon clifti** *Falc. & Cau.*	*Shōdo, Sanuki.*
478.	**Elephas primigenius** *Blum.*	*Hishiike, Mikawa.*
479.	**Sus japonicus** *Yosh.*	*Ryuge, Ugo.*

(6) WHETSTONES, PORCELAIN CLAYS AND PHOSPHATES

(a) WHETSTONES

The chief whetstones now in common use in Japan are collected and exhibited here. The collection comprise several kinds of whetstones of various textures, and of different characters, being of sedimentary or eruptive origin. Among them, those of liparites and their tuffs, for instance those like the *Nagura-do, Jōkenjido,* **etc. are rather remarkable and are considered to fit for exportation to foreign countries.**

No.	Name	Locality
480.	**Adinole Slate** (*Narutakido*)	*Umegahata, Yamashiro.*
481.	„ „ (*Otsukido*)	„ „
482.	**Striped Adinole Slate** (*Inoshirodo*)	„ „
483.	**Adinole Slate** (*Kaburikodo*)	„ „

No.	Name	Locality
484.	**Adinole Slate** (*Kizuyamado*)	***Udano, Yamashiro.***
485.	„ „ (*Shōbudo*)	***Umegahata,*** „
486.	„ „ (*Okudono-Suitado*)	„ „
487.	**Clay Slate** (*Yagi-Izarido*)	***Yagi, Tamba.***
488.	**Adinole Slate** (*Okudonodo*)	***Umegahata, Yamashiro.***
489.	„ „ (*Yagi-Nagaodo*)	***Yagi, Tamba.***
490.	**Clay Slate** (*Ōuchido*)	***Ōuchi,*** „
491.	**Metamorphosed Clay Slate** (*Sukegawado*)	***Sukegawa, Hitachi.***
492.	**Clay Slate** (*Uchigumorido*)	***Saga, Yamashiro.***
493.	„ „ (*Aoto*)	***Kōzaki, Tamba.***
494.	**Mottled Slate** (*Ashiyado*)	***Ōuchi,*** „
495.	**Liparite Tuff** (Yellow *Nagurado*)	***Ōnomura, Mikawa.***
496.	**Liparite Tuff** (White *Nagurado*)	„ „
497.	**Finely Spotted Slate** (*Yagi-Matsumotodo*)	***Yagi, Tamba.***
498.	**Metamorphosed Clay Slate** (*Mearado*)	***Ōuchi,*** „
499.	**Metamorphosed Clay Slate** (*Akado*)	***Igura,*** „
500.	**Metamorphosed Slate** (*Akado*)	„ „
501.	**Spotted Slate** (*Akado*)	***Nishinaka, Hitachi.***
502.	**Metamorphosed Slate** (*Kasagido*)	***Kiya, Yamashiro.***
503.	**Spotted Slate** (*Aoto*)	***Kōzaki, Tamba.***
504.	**Spotted Sandy Slate** (*Mitanido*)	***Mitani, Shimotsuke.***
505.	**Metamorphosed Spotted Slate** (*Medōshido*)	***Kōzaki, Tamba.***
506.	**Metamorphosed Spotted Slate** (*Saekido*)	***Igura,*** „
507.	**Spotted Slate** (*Monzendo*)	***Naka, Yamashiro.***
508.	**Rhyolite** (*Iyodo*)	***Toyama, Iyo.***
509.	„ „	***Karakawa, Iyo.***
510.	„ (*Aka-Amakusado*)	***Oyano, Higo.***

No.	Name	Locality
511.	**Rhyolite** (*Kōzuke-Torado*)	***Tozawa, Kōzuke.***
512.	**Liparite** (*Yukawado*)	***Yukawa, Kii.***
513.	" (*Iyodo*)	***Karakawa, Iyo.***
514.	" (*Shiro-Amakusado*)	***Oyano, Higo.***
515.	" (*Iyodo*)	***Toyama, Iyo.***
516.	" "	" "
517.	**Dacite** (*Shirodo*)	***Aizu, Iwashiro.***
518.	**Liparite** (*Kōzuke-Shirodo*)	***Tosawa, Kōzuke.***
519.	**Dacite** (*Kōzukedo*)	" "
520.	**Andesite** (*Kazama-Nagurado*)	***Kazama, Uzen.***
521.	" (*Tajimado*)	***Moroyose, Tajima.***
522.	**Hornblende-andesite** (White *Jōkenjido*)	***Jichu, Echizen.***
523.	**Hornblende-andesite** (*Jokenjido*)	" "
524.	**Fine-grained Sandstone** (*Hon-Ōmurado*)	***Irino, Iwashiro.***
525.	**Fine-grained Sandstone** (*Tosado*)	***Shishikuiura, Awa (Shikoku).***
526.	**Fine-grained Sandstone** (*Ōmurado*)	***Katada, Kii.***
527.	**Banded Sandstone** (*Chamikodo*)	" "
528.	**Fine-grained Sandstone** (*Hibido*)	***Matsushima, Hizen.***
529.	" " " (*Chōshido*)	***Chōshi, Shimōsa.***
530.	" " " "	" "
531.	" " " (*Shiro-Matsudo*)	***Tsuzurabuchi, Kii.***
532.	" " " (*Gotōdo*)	***Hirashima, Hizen.***
533.	**Medium-grained Sandstone** (*Hirashimado*)	" "
534.	**Medium-grained Sandstone** (*Sasaguchido*)	***Kosasa, Hizen.***
535.	**Medium-grained Sandstone** (*Matsushimado*)	***Matsushima, Hizen.***
536.	**Medium-grained Siliceous Sandstone** (*Ishigayado*)	***Katada, Kii.***
537.	**Medium-grained Siliceous Sandstone** (*Jōjirodo*)	***Saino,*** "
538.	**Medium-grained Siliceous Sandstone** (*Shiro-Eguchido*)	***Eguchi, Hizen.***

(b) PORCELAIN CLAYS, ETC.

This is a collection of specimens of raw and prepared materials for the bodies of the chief porcelains and stone-wares of Japan. The result of the analysis of each material is given in most cases on the label accompanying it, and the proportions of materials, employed in the mixture for the bisque, are respectively noticed under its proper head.

1. MATERIALS FOR THE BODY OF ARITA PORCELAIN (*Arita-yaki*)

No.	Name	Locality
539.	**Decomposed Liparite** (*Izumiyama-ishi*)	***Arita, Hizen.***
540.	**Decomposed Liparite** (*Amakusa-ishi*)	***Amakusa, Higo.***
541.	**Pulverized Mixture of** *Izumi-yama-ishi and Amakusa-ishi*	
542.	**Elutriated Paste for the Bisque, consisting of** {4 vols. of *Izumiyama-ishi*; 1 vol. ,, *Amakusa-ishi*}	

2. MATERIALS FOR THE BODY OF KYŌTO PORCELAIN (*Kiyomizu-yaki*)

543.	**Decomposed Liparite** (*Takahama-ishi*)	***Amakusa, Higo.***
544.	**Pulverized and Washed** *Taka-hama-ishi*	,, ,,
545.	**Decomposed Granite** (*Tokiguchi-Gairome*)	***Tokiguchi, Mino.***
546.	**Pulverized and Washed** *Tokiguchi-Gairome*	,, ,,
547.	**Decomposed Granite** (*Takao-Gairome*)	***Takao, Yamashiro.***
548.	**Pulverized and Washed** *Takao-Gairome*	,, ,,

No.	Name	Locality
549.	**Quartz** (*Sanuki-Keiseki*)	***Hiroshima, Sanuki.***
550.	**Feldspar** (*Chōseki*)	***Mikumo, Ōmi.***
551.	**Pulverized and Washed** *Chōseki*	„ „
552.	**Re-deposited Clay from Decomposed Granite** (*Shigaraki-zuchi*)	***Kinose,*** „
553.	**Pulverized and Washed** *Shigaraki-zuchi*	„ „
554.	**Elutriated Paste for the Bisque, consisting of** 7 parts of *Takahama-ishi*, 1 part „ *Tokiguchi-gairome*, 1 „ „ *Chōseki*, 1 „ „ *Keiseki* (in weight)	

3. MATERIALS FOR THE BODY OF AWADA STONE-WARE (*Awada-yaki*)

No.	Name	Locality
555.	**Agalmatolite** (*Rōseki*)	***Mitsuishi, Bizen.***
556.	**Pulverized and Washed** *Rōseki*	„ „
557.	**Decomposed Quartz-porphyry** (*Rokujizō-Mazetsuchi*)	***Rokujizō, Ōmi.***
558.	**Pulverized and Washed** *Rokujizō-Mazetsuchi*	„ „
559.	**Clay from Decomposed Granite** (*Shigaraki-zuchi*)	***Kinose,*** „
560.	**Kaolin** (*Shiroe-zuchi*)	***Shimoda,*** „
561.	**Clay from Decomposed Granite** (*Nendo*)	***Shinohara,*** „
562.	**Pulverized and Washed** *Nendo*	„ „
563.	**Decomposed Aplite** (*Yada-Mazetsuchi*)	***Yada, Yamato.***
564.	**Pulverized and Washed** *Yada-Mazetsuchi*	„ „
565.	**Carbonaceous Clay** (*Imayama-Kibushi*)	***Imayama, Yamashiro.***
566.	**Pulverized** *Imayama-Kibushi*	„ „
567.	**Slightly Carbonaceous Clay** (*Asamiya-Kibushi*)	***Asamiya, Ōmi.***

No.	Name	Locality
568.	**Pulverized and Washed** *Asamiya-Kibushi*	***Asamiya, Ōmi.***
569.	**Elutriated Paste for the Bisque, consisting of** 10 vols. of *Rōseki*, 10 ,, ,, *Mazetsuchi*, 15 ,, ,, *Shigarakizuchi*	

4. MATERIALS FOR THE BODY OF SATSUMA STONE-WARE (*Satsuma-yaki*)

570.	**Decomposed Andesite (Kaolin)** (*Kirishima-tsuchi*)	***Kirishimayama, Ōsumi.***
571.	**Decomposed Andesite** (*Bara-tsuchi*)	***Higashikata, Satsuma.***
572.	**Siliceous Tuff** (*Kaseda-zuna*)	***Kaseda,*** ,,
573.	**Elutriated Paste for the Bisque, consisting of** 3 vols. of *Kirishima-tsuchi*, 18 ,, ,, *Bara-tsuchi*, 13 ,, ,, *Kaseda-zuna*	

5. MATERIALS FOR THE BODY OF AWAJI STONE-WARE (*Awaji-yaki*)

574.	**Re-deposited Clay from Decomposed Granite** (*Ono-tsuchi*)	***Ono, Awaji.***
575.	**Elutriated Paste for the Bisque, consisting of** *Ono-tsuchi*	

6. MATERIALS FOR THE BODY OF KAGA PORCELAIN (*Kutani-yaki*)

576.	**Decomposed Liparite** (*Hanasaka-tsuchi*)	***Hanasaka, Kaga.***
577.	**Washed** *Hanasaka-tsuchi*	,, ,,
578.	**Decomposed Liparite** (*Gokokuji-tsuchi*)	***Gokokuji,*** ,,
579.	**Washed** *Gokokuji-tsuchi*	,, ,,
580.	**Decomposed Liparite** (*Nabetani-ishi*)	***Nabetani,*** ,,
581.	**Washed** *Nabetani-ishi*	,, ,,

582. **Elutriated Paste for the Bisque,**

consisting of {5 vols. of *Hanasaka-tsuchi*, 5 „ „ *Gokokuji-tsuchi*, 3 „ „ *Nabetani-ishi*}

7. MATERIALS FOR THE BODY OF AIZU PORCELAIN (*Aizu-yaki*)

No.	Name	Locality
583.	**Decomposed Liparite** (*Ōkubo-ishi*)	***Hongō, Iwashiro.***
584.	**Pulverized** *Ōkubo-ishi*	„ „
585.	**Decomposed Liparite** (*Kabuto-ishi*)	***Oki,*** „
586.	**Pulverized** *Kabuto-ishi*	„ „
587.	**Decomposed Liparite** (*Jari-ishi*)	***Hongō,*** „
588.	**Pulverized** *Jari-ishi*	„ „

589. **Elutriated Paste for the Bisque,**

consisting of {3 vols. of *Ōkubo-ishi*, 3 „ „ *Jari-ishi*, 2 „ „ *Kabuto-ishi*}

8. MATERIALS FOR THE BODY OF SETO PORCELAIN (*Seto-yaki*)

590.	**Decomposed Granite** (*Gairome*)	***Yamaguchi, Owari.***
591.	**Pulverized and Washed** *Gairome*	„ „
592.	**Feldspar** (*Chōseki*)	***Takaoka, Mikawa.***
593.	**Washed** *Chōseki*	„ „
594.	**Quartz mixed with Feldspar** (*Keiseki*)	***Sarunage, Mikawa.***
595.	**Pulverized** *Keiseki*	„ „

596. **Elutriated Paste for the Bisque,**

consisting of {10 vols. of *Gairome*, 5 „ „ *Chōseki*, 2 „ „ *Keiseki*}

9. MATERIALS FOR THE BODY OF TAJIMI PORCELAIN (*Tajimi-yaki*)

597.	**Decomposed Granite** (*Tokiguchi-Gairome*)	***Tokiguchi, Mino.***
598.	**Washed** *Tokiguchi-Gairome*	„ „

No.	Name	Locality
599.	**Feldspar** (*Chōseki*)	*Ōhira, Mikawa.*
600.	**Washed** *Chōseki*	,, ,,
601.	**Quartz** (*Keiseki*)	*Tsumagi, Mino.*
602.	**Washed** *Keiseki*	,, ,,
603.	**Elutriated Paste for the Bisque,**	

consisting of { 2 vols. of *Gairome*; 3 ,, ,, *Chōseki*; 5 ,, ,, *Keiseki* }

(c) PHOSPHATES

Of late, phosphates have come to be known to occur in many places in Japan. The specimens, here exhibited, are principal types of them, and they represent various forms of phosphates, hitherto found in Japan. Percentage of P_2O_5 contained in each specimen is described on the label attached to it.

No.	Name	Locality
604.	**Nodule Phosphate**	*Urakawa, Hidaka.*
605.	,, ,,	*Yamamoto, Mutsu.*
606.	,, ,,	*Niageba, Ugo.*
607.	,, ,,	*Sochi, Echigo.*
608.	,, ,,	,, ,,
609.	,, ,,	*Nakanosako, Hyūga.*
610.	**Rock Phosphate**	*Sakegawa, Uzen.*
611.	,, ,,	*Arayama, Shinano.*
612.	,, ,,	*Toba, Shima.*
613.	**Soft Phosphate**	*Hiuchidani, Noto.*
614.	,, ,,	*Kita-nakasato, Hitachi.*
615.	**Guano Phosphate**	*Minami-Torishima (Marcus Island).*
616.	,, ,,	,,
617.	,, ,,	,,

(7) CRUDE PETROLEUM

Of Japanese crude petroleum, there are many varieties, belonging to the naphta series and found in Tertiary strata. The specimens here exhibited are types collected from the principal oil fields in the Empire. The results of fractional distillation are respectively shown on the accompanying labels.

No.	Name	Locality
618.	Crude Petroleum	*Izumi, Ugo.*
619.	" "	*Oguni,* "
620.	" "	*Niitsu, Echigo.*
621.	" "	*Amaze,* "
622.	" "	*Nagamine,* "
623.	" "	*Aburaden,* "
624.	" "	*Miyagawa,* "
625.	" "	*Katsubozawa,* "
626.	" "	*Hire,* "
627.	" "	*Uraze,* "
628.	" "	*Takezawa,* "
629.	" "	*Ojiya,* "
630.	" "	*Hara,* "
631.	" "	*Hiyama,* "
632.	" "	*Sagara, Tōtōmi.*

(8) SOILS

The specimens of soils with the products of their mechanical analyses, here exhibited, include most of the important ones constituting the arable land of Japan. They are arranged according to their localities as follows:—

No.	Name	Locality
633.	Clay (Young Quaternary)	*Ima, Bizen.*
634.	Humus Clay (Volcanic Detritus)	*Kawadai, Uzen.*
635.	" " (Old Quaternary)	*Sakai, Musashi.*
636.	Loamy Clay (Young Quaternary)	*Nagaoka, Echigo.*

No.	Name	Locality
637.	**Schottery Clay (Chlorite-schist)**	*Yamashirodani, Awa (Shikoku).*
638.	**Loam (Tertiary Tuff)**	*Kakegawa, Tōtōmi.*
639.	**„ (Old Quaternary)**	*Tokachi, Hokkaidō.*
640.	**Sandy Loam (Lapilli)**	*Gotemba, Suruga.*
641.	**Schottery Loam (Palaeozoic Pyroxenite)**	*Yamadahara, Kii.*
642.	**Schottery Loam (Palaeozoic Slate)**	*Uji, Yamashiro.*
643.	**„ „ (Mesozoic Shale)**	*Amakusa, Higo.*
644.	**Loamy Sand (Granite)**	*Ogyu, Mikawa.*
645.	**„ „ (Granitic Gneiss)**	*Nihommatsu, Iwashiro.*
646.	**„ „ (Young Quaternary)**	*Kurihashi, Musashi.*
647.	**Loamy Schotter (Mesozoic Sandstone)**	*Ono, Tosa.*

THE

ANALYTICAL RESULTS

OF

THE SPECIMENS OF SOILS

EXHIBITED BY

THE IMPERIAL GEOLOGICAL SURVEY

AT

THE LOUISIANA PURCHASE EXPOSITION

HELD AT

ST. LOUIS, Mo. U.S.A.

1904.

633

KIND OF SOIL. Clay (Young Quaternary)

LOCALITY. Ima, Bizen

Mechanical Compositions

Over 10 mm.	0.00
10—8 ,,	0.00
8—6 ,,	0.00
6—4 ,,	0.00
Sum of Gravel	0.00
Fine Soil %	**100.00**
Fine Soil Consists of:—	
4—3 mm.	0.02
3—2 ,,	0.14
2—1 ,,	0.66
1—0.5 ,,	1.76
0.5—0.25 ,,	1.62
0.25—0.1 ,,	1.92
0.1—0.05 ,,	4.10
0.05—0.01 ,,	12.42
0.01>	77.36
Fine-earthy Part Consists of:—	
0.5—0.25 mm.	1.66
0.25—0.1 ,,	1.98
0.1—0.05 ,,	4.21
0.05—0.01 ,,	12.74
0.01>	79.41
Fine-earthy Part %	
In Fine Soil	**97.42**
In Orig. Soil	**97.42**

Chemical Constituents

	Weight %		Volume %	
	Air dry	Dried 110° C.	Loose	Compact
Moisture		7.128	4.990	7.648
Loss on ignition		10.811	7.028	10.773
C. (in humus)				
Total N. (,,)				
Insoluble residue		**48.594**	**31.584**	**48.414**
SiO_2 Sol. in HCl		0.398	0.259	0.407
SiO_2 Sol. in Na_2CO_3		12.921	8.400	12.976
Sum of SiO_2		**13.319**	**8.659**	**13.283**
Al_2O_3		13.578	8.750	13.414
Fe_2O_3		1.825	1.187	1.819
FeO		9.212	5.989	9.180
Mn_2O_3		0.223	0.144	0.222
CaO		0.267	0.173	0.265
MgO		0.775	0.505	0.773
K_2O		**0.012**	**0.008**	**0.012**
Na_2O		0.013	0.008	0.012
P_2O_5		**0.193**	**0.125**	**0.193**
SO_3		0.207	0.134	0.206
Sulphuric acid Extract				
Al_2O_3 & Fe_2O_3		4.164	2.728	4.152
SiO_2		4.242	2.757	4.225

Absorption Experiment

P_2O_5 Coeficient		814.080	
N. ,,		309.120	
Calculated for Fine Soil		Calculated for Original Soil	
K_2O	0.011	K_2O	0.011
P_2O_5	0.174	P_2O_5	0.174
P_2O_5 Absorp.	793.077	P_2O_5 Absorp.	793.077
N. ,,	301.141	N. ,,	301.141

Physical Properties

		Loose	Compact
Specific Gravity		2.600	
Weight of 100 cc.		70.00	107.30
Volume Weight (Apparent Sp. Gr.)		0.650	0.997
100 Gr., soil settled in water cc.		150.00	
Weight of soil for filling 100 cc. under water		66.67	
Water Capacity, Weight %		90.87	61.50
Solid Part %		25.00	38.33
Pores %		75.00	61.67
Water Capacity, Vol. %		59.08	60.60
In air dry soil (Max. permeability)		70.01	54.02
In water saturated soil (Min. permeability)		15.92	0.39
Time required for imbibing water to the height of 10 cm.		0h 56′	2h 35′
Per Hecter to the depth 10 cm. in water saturated state containing	Air cbm.	700.06	540.24
	Water cbm.	159.21	3.87
Mechanical Composition of Fine-earthy part in 100 cc.	0.5-0.25mm.	1.16	1.78
	0.25-0.1 ,,	1.39	2.12
	0.1-0.05 ,,	2.95	4.52
	0.05-0.01 ,,	8.92	13.67
	0.01> ,,	55.59	85.21
In 100 cc.	C. (In humus)		
	Hygros Water	4.99	7.65

REMARK :—

A well known Rush (Juncus Effusus) district of Japan

634

Kind of Soil. Humus Clay (Volcanic Detritus)

Locality. Kawadai, Uzen

Mechanical Compositions

Over 10 mm.	0.00
10—8 ,,	0.00
8—6 ,,	0.00
6—4 ,,	0.00
Sum of Gravel	0.00
Fine soil %	**100.00**
Fine Soil Consists of:—	
4—3 mm.	0.04
3—2 ,,	0.02
2—1 ,,	0.10
1—0.5 ,,	0.18
0.5 —0.25 ,,	0.78
0.25—0.1 ,,	0.34
0.1 —0.05 ,,	2.22
0.05—0.01 ,,	27.66
0.01>	68.82
Fine-earthy Part Consists of:—	
0.5 —0.25 mm.	0.78
0.25—0.1 ,,	0.34
0.1 —0.05 ,,	2.24
0.05—0.01 ,,	27.71
0.01>	68.94
Fine-earthy Part %	
In Fine Soil	**99.82**
In Orig. Soil	**99.82**

Chemical Constituents

	Weight %		Volume %	
	Air dry	Dried 110° c.	Loose	Compact
Moisture		9.500	4.863	7.781
Loss on ignition		17.790	8.242	13.186
C. (in humus)		7.445	3.449	5.518
Total N. (,,)		**0.592**	**0.274**	**0.439**
Insoluble residue		**64.262**	**29.771**	**47.651**
SiO_2 Sol. in HCl		0.291	0.135	0.216
SiO_2 Sol. in Na_2CO_3		8.487	3.932	6.291
Sum of SiO_2		**8.778**	**4.067**	**6.507**
Al_2O_3		2.762	1.280	2.048
Fe_2O_3		0.838	0.388	0.621
FeO		2.197	1.018	1.629
Mn_2O_3		0.309	0.143	0.229
CaO		0.632	0.293	0.469
MgO		0.672	0.311	0.498
K_2O		**0.476**	**0.220**	**0.353**
Na_2O		0.287	0.133	0.213
P_2O_5		**0.140**	**0.065**	**0.104**
SO_3		0.113	0.052	0.084
Sulphuric acid Extract				
Al_2O_3 & Fe_2O_3		4.654	2.156	3.449
SiO_2		6.606	3.060	4.896

Absorption Experiment

P_2O_5 Coeficient	1090.890
N. ,,	533.840

Calculated for Fine Soil		Calculated for Original Soil	
K_2O	0.429	K_2O	0.429
P_2O_5	0.126	P_2O_5	0.126
P_2O_5 Absorp.	1090.890	P_2O_5 Absorp.	1090.890
N. ,,	533.840	N. ,,	533.840

Physical Properties

		Loose	Compact
Specific Gravity		2.507	
Weight of 100 cc.		51.19	81.90
Volume Weight (Apparent Sp. Gr.)		0.463	0.741
100 Gr., soil settled in water cc.		176.00	
Weight of soil for filling 100 cc. under water		56.80	
Water Capacity, Weight %		110.86	73.80
Solid Part %		18.48	29.57
Pores %		81.52	70.43
Water Capacity, Vol. %		51.36	54.70
In air dry soil (Max. permeability)		76.66	62.65
In water saturated soil (Min permeability)		30.16	15.73
Time required for imbibing water to the height of 10 cm.		28′	1h 57′
Per Hecter to the depth 10 cm. in water saturated state containing	Air cbm.	301.63	157.34
	Water cbm.	513.58	547.01
Mechanical Composition of Fine-earthy part in 100 cc.	0.5-0.25mm	0.40	0.64
	0.25-0.1 ,,	0.17	0.28
	0.1 -0.05 ,,	1.15	1.84
	0.05-0.01 ,,	14.19	22.69
	0.01> ,,	35.29	56.46
In 100 cc.	C. (In humus)	3.45	5.52
	Hygros. Water	4.80	7.78

Remark:—

Surface soil of pasture land at the foot of Gassan volcano

635

Kind of Soil. Humus Clay (Old Quaternary)

Locality. Sakai, Musashi

Mechanical Compositions

Over 10 mm.	0.00
10—8 "	0.00
8—6 "	0.00
6—4 "	0.00
Sum of Gravel	0.00
Fine Soil %	100.00
Fine Soil Consists of:—	
4—3 mm.	0.00
3—2 "	0.01
2—1 "	0.18
1—0.5 "	0.74
0.5 —0.25 "	6.42
0.25—0.1 "	3.54
0.1 —0.05 "	8.01
0.05—0.01 "	28.68
0.01>	52.42
Fine-earthy Part Consists of.—	
0.5 —0.25 mm.	6.48
0.25—0.1 "	3.57
0.1 —0.05 "	8.09
0.05—0.01 "	28.95
0.01>	52.91
Fine-earthy Part %	
In Fine Soil	99.07
In Orig. Soil	99.07

Chemical Constituents

	Weight % Air dry	Weight % Dried 110° c.	Volume % Loose	Volume % Compact
Moisture		20.850	13.900	19.450
Loss on ignition		25.237	13.376	18.574
C. (in humus)				
Total N. (")		0.121	0.064	0.089
Insoluble residue		19.858	10.525	14.615
SiO_2 Sol. in HCl		0.546	0.289	0.402
SiO_2 Sol. in Na_2CO_3		17.331	9.185	12.756
Sum of SiO_2		17.877	9.474	13.158
Al_2O_3		16.172	8.574	11.903
Fe_2O_3		3.166	1.675	2.326
FeO		10.680	5.660	7.860
Mn_2O_3		0.000	0.000	0.000
CaO		1.685	0.893	1.240
MgO		1.637	0.868	1.205
K_2O		0.137	0.073	0.101
Na_2O		0.314	0.166	0.231
P_2O_5		0.148	0.079	0.109
SO_3		0.323	0.171	0.238
Sulphuric acid Extract				
Al_2O_3 & Fe_2O_3		11.789	6.284	8.677
SiO_2		9.567	5.071	7.041

Absorption Experiments

P_2O_5 Coeficient	2238.650
N. "	697.968

Calculated for Fine Soil		Calculated for Original Soil	
K_2O	0.108	K_2O	0.108
P_2O_5	0.116	P_2O_5	0.116
P_2O_5 Absorp.	2217.831	P_2O_5 Absorp.	2217.831
N. "	691.477	N. "	691.477

Physical Properties

		Loose	Compact
Specific Gravity		2.528	
Weight of 100 cc.		66.90	93.05
Volume Weight (Apparent Sp. Gr.)		0.530	0.736
100 Gr., soil settled in water cc.		155.00	
Weight of soil for filling 100 cc. under water		64.52	
Water Capacity, Weight %		123.31	90.86
Solid Part %		20.97	29.11
Pores %		79.04	70.89
Water Capacity, Vol. %		65.35	66.87
In air dry soil (Max. permeability)		65.14	51.44
In water saturated soil (Min. permeability)		13.68	14.02
Time required for imbibing water to the height of 10 cm.		50′	1h 18′
Per Hecter to the depth to cm. in water saturated state containing	Air cbm.	136.81	140.17
	Water cbm.	653.54	668.69
Mechanical Composition of Fine-earthy part in 100 cc.	0.5–0.25 mm.	4.34	6.03
	0.25–0.1 "	2.39	3.322
	0.1 –0.05 "	5.41	7.53
	0.05–0.01 "	19.37	26.94
	0.01> "	35.40	49.23
In 100 cc.	C. (In humus)		
	Hygros. Water	13.90	19.45

Remark:—

A typical soil of Kwantō plain

636

Kind of Soil. Loamy Clay (Young Quarternary)

Locality. Nagaoka, Echigo

Mechanical Compositions

Over 10 mm.	0.19
10—8 ,,	0.04
8—6 ,,	0.07
6—4 ,,	0.04
Sum of Gravel	0.34
Fine Soil %	**99.66**
Fine Soil Consists of :—	
4—3 mm.	0.06
3—2 ,,	0.04
2—1 ,,	0.12
1—0.5 ,,	0.30
0.5 —0.25 ,,	1.20
0.25—0.1 ,,	7.66
0.1 —0.05 ,,	14.76
0.05—0.01 ,,	25.14
0.01>	50.72
Fine-earthy Part Consists of :—	
0.5 —0.25 mm.	1.21
0.25—0.1 ,,	7.70
0.1 —0.05 ,,	14.84
0.05—0.01 ,,	25.27
0.01>	50.99
Fine-earthy Part %	
In Fine Soil	**99.48**
In Orig. Soil	**99.14**

Chemical Constituents

	Weight % Air dry	Weight % Dried 110° c.	Volume % Loose	Volume % Compact
Moisture		4.230	3.350	5.837
Loss on ignition		3.916	2.967	5.175
C. (in humus)				
Total N. (,,)		**0.173**	**0.133**	**0.232**
Insoluble residue		**68.338**	**51.834**	**90.317**
SiO_2 Sol. in HCl		0.078	0.059	0.102
SiO_2 Sol. in Na_2CO_3		11.153	8.459	14.740
Sum of SiO_2		**11.231**	**8.518**	**14.842**
Al_2O_3		3.529	2.724	4.747
Fe_2O_3		4.989	3.784	6.594
FeO		2.370	1.798	3.133
Mn_2O_3		0.249	0.189	0.328
CaO		0.482	0.365	0.636
MgO		1.158	0.878	1.530
K_2O		**0.127**	**0.131**	**0.228**
Na_2O		0.133	0.101	0.175
P_2O_5		**0.107**	**0.081**	**0.141**
SO_3		0.030	0.023	0.036
Sulphuric acid Extract				
Al_2O_3 & Fe_2O_3		3.160	2.397	4.176
SiO_2		6.203	4.781	8.330

Absorption Experiment

P_2O_5 Coeficient	736.000
N. ,,	294.630

Calculated for Fine Soil		Calculated for Original Soil	
K_2O	0.164	K_2O	0.164
P_2O_5	0.102	P_2O_5	0.102
P_2O_5 Absorp.	732.173	P_2O_5 Absorp.	729.670
N. ,,	293.092	N. ,,	292.096

Physical Properties

		Loose	Compact
Specific Gravity		2.712	
Weight of 100 cc.		79.2	136.0
Volume Weight (Apparent Sp. Gr.)		0.750	1.238
100 Cr., soil settled in water cc.		106.	
Weight of soil for filling 100 cc. under water		94.339	
Water Capacity, Weight %		60.577	36.290
Solid Part %		27.655	45.640
Pores %		72.345	54.351
Water Capacity, Vol. %		45.433	45.338
In air dry soil (Max. permeability)		68.995	48.514
In water saturated soil (Min. permeability)		26.912	9.311
Time required for imbibing water to the height of 10 cm.		39′	4h 24′
Per Hecter to the depth 10 cm. in water saturated state containing	Air cbm.	269.12	93.11
	Water cbm.	454.33	453.38
Mechanical Composition of Fine-earthy part in 100 cc.	0.5-0.25 mm.	0.958	1.670
	0.25-0.1 ,,	6.098	10.626
	0.1 -0.05 ,,	11.753	20.479
	0.05-0.01 ,,	19.914	34.873
	0.01> ,,	40.384	70.366
In 100 cc.	C. (in humus)		
	Hygros Water	3.350	5.837

Remark :—

Surface soil of the extensive paddy field of Japan

637

Kind of Soil. Schottery Clay (Chlorite-schist)

Locality. Yamashirodani, Awa (Shikoku)

Mechanical Compositions

Over 10 mm.	20.31
10—8 „	2.74
8—6 „	2.60
6—4 „	4.02
Sum of Gravel	29.67
Fine Soil %	70.33
Fine Soil Consists of:—	
4—3 mm.	3.70
3—2 „	5.44
2—1 „	6.88
1—0.5 „	5.41
0.5—0.25 „	3.85
0.25—0.1 „	3.02
0.1—0.05 „	7.90
0.05—0.01 „	21.68
0.01>	42.12
Fine-earthy Part Consists of:—	
0.5—0.25 mm.	4.99
0.25—0.1 „	3.84
0.1—0.05 „	10.06
0.05—0.01 „	27.59
0.01>	53.61
Fine-earthy Part %	
In Fine Soil	78.57
In Orig. Soil	55.26

Chemical Constituents

	Weight %		Volume %	
	Air dry	Dried 110° c.	Loose	Compact
Moisture		4.140	3.670	5.930
Loss on ignition		7.448	6.330	10.232
C. (in humus)				
Total N. („)				
Insoluble residue		**66.121**	**56.189**	**90.828**
SiO_2 Sol. in HCl		0.968	0.823	1.330
SiO_2 Sol. in Na_2CO_3		10.859	9.228	14.916
Sum of SiO_2		**11.827**	**10.050**	**16.246**
Al_2O_3		7.720	6.560	10.604
Fe_2O_3		2.176	1.849	2.989
FeO		2.548	2.166	3.501
Mn_2O_3		0.774	0.660	1.068
CaO		0.640	0.544	0.880
MgO		1.048	0.891	1.440
K_2O		**0.259**	**0.220**	**0.353**
Na_2O		0.115	0.098	0.158
P_2O_5		**0.106**	**0.090**	**0.145**
SO_3		0.049	0.042	0.067
Sulphuric acid Extract				
Al_2O_3 & Fe_2O_3		10.244	8.705	14.072
SiO_2		8.992	7.641	11.422

Absorption Experiment

P_2O_5 Coeficient	830.650
N. „	232.630

Calculated for Fine Soil		Calculated for Original Soil	
K_2O	0.195	K_2O	0.137
P_2O_5	0.070	P_2O_5	0.056
P_2O_5 Absorp.	625.642	P_2O_5 Absorp.	459.017
N. „	182.801	N. „	128.568

Physical Properties

		Loose	Compact
Specific Gravity		2.6505	
Weight of 100 cc.		88.65	143.30
Volume Weight (Apparent Sp. Gr.)		0.849	1.372
100 Gr., soil settled in water cc.		100.00	
Weight of soil for filling 100 cc. under water		100.00	
Water Capacity, Weight %		56.00	35.05
Solid Part %		32.02	52.14
Pores %		67.98	47.87
Water Capacity, Vol. %		47.53	48.07
In air dry soil (Max. permeability)		64.21	41.76
In water saturated soil (Min. permeability)		20.45	-1.21
Time required for imbibing water to the height of 10 cm.		1h 03′	4h
Per Hecter to the depth 10 cm, in water saturated state containing	Air cbm.	204.52	-120.8
	Water cbm.	475.29	480.7
Mechanical Composition of Fine-earthy part in 100 cc.	0.5–0.25 mm	4.34	7.02
	0.25–0.1 „	3.40	5.50
	0.1–0.05 „	8.92	14.42
	0.1–0.05 „	24.46	39.54
	0.01> „	47.53	76.82
In 100 cc.	C. (In humus)		
	Hygros. Water	3.78	6.11

Remark:—

Soil producing a large quantity of Tobacco

638

Kind of Soil. Loam (Tertiary Tuff)

Locality. Kakegawa, Tōtōmi

Mechanical Compositions

Over 10 mm.	0.28
10—8 „	0.23
8—6 „	0.31
6—4 „	0.63
Sum of Gravel	1.45
Fine Soil %	**98.55**
Fine Soil Consists of:—	
4—3 mm.	0.25
3—2 „	1.03
2—1 „	2.20
1—0.5 „	2.25
0.5—0.25 „	2.85
0.25—0.1 „	11.24
0.1—0.05 „	23.43
0.05—0.01 „	18.36
0.01>	38.39
Fine-earthy Part Consists of:—	
0.5—0.25 mm.	3.02
0.25—0.1 „	11.92
0.1—0.05 „	24.86
0.05—0.01 „	19.48
0.01>	40.72
Fine-earthy Part %	
In Fine Soil	**94.27**
In Orig. Soil	**93.00**

Chemical Constituents

	Weight %		Volume %	
	Air dry	Dried 110° c.	Loose	Compact
Moisture		5.575	5.210	7.537
Loss on ignition		5.081	4.486	6.490
C. (in humus)				
Total N. („)		**0.226**	**0.189**	**0.273**
Insoluble residue		**73.152**	**64.557**	**93.388**
SiO_2 Sol. in HCl		0.408	0.360	0.521
SiO_2 Sol. in Na_2CO_3		8.558	7.553	10.926
Sum of SiO_2		**8.966**	**7.913**	**11.447**
Al_2O_3		6.884	5.563	8.778
Fe_2O_3		2.450	1.908	3.127
FeO		1.391	1.083	1.775
Mn_2O_3		0.186	0.145	0.238
CaO		0.531	0.426	0.668
MgO		2.172	1.916	2.772
K_2O		**0.125**	**0.110**	**0.156**
Na_2O		0.128	0.113	0.164
P_2O_5		**0.053**	**0.041**	**0.068**
SO_3		0.021	0.017	0.027
Sulphuric acid Extract				
Al_2O_3 & Fe_2O_3		4.057	3.580	5.180
SiO_2		2.261	1.995	2.887

Absorption Experiments

P_2O_5 Coeficient	619.520
N. „	256.620

Calculated for Fine Soil		Calculated for Original Soil	
K_2O	0.111	K_2O	0.111
P_2O_5	0.047	P_2O_5	0.046
P_2O_5 Absorp.	584.021	P_2O_5 Absorp.	576.154
N. „	241.914	N. „	238.655

Physical Properties

		Loose	Compact
Specific Gravity		2.693	
Weight of 100 cc.		93.46	135.20
Volume Weight (Apparent Sp. Gr.)		0.885	1.280
100 Gr., soil settled in water cc.		96.00	
Weight of soil for filling 100 cc. under water		104.17	
Water Capacity, Weight %		58.99	38.84
Solid Part %		32.86	47.52
Pores %		67.14	52.47
Water Capacity, Vol. %		52.21	49.72
In air dry soil (Max. permeability)		62.18	45.29
In water saturated soil (Min. permeability)		14.93	2.74
Time required for imbibing water to the height of 10 cm.		08'	1h 23'
Per Hecter to the depth 10 cm. in water saturated state containing	Air cbm.	149.28	27.43
	Water cbm.	522.12	477.23
Mechanical Composition of Fine-earthy part in 100 cc.	0.5—0.25 mm.	2.92	4.08
	0.25—0.1 „	11.14	16.12
	0.1—0.05 „	23.23	33.61
	0.05—01 „	18.21	26.33
	0.01> „	38.06	55.05
In 100 cc.	C. (In humus)		
	Hygros. Water	4.96	7.18

Remark:—

A well known tea district of Japan

639

Kind of Soil. Loam (Old Quaternary)

Locality. Tokachi, Hokkaidō

Mechanical Compositions

Over 10 mm.	0.00
10—8 ,,	0.00
8—6 ,,	0.00
6—4 ,,	0.00
Sum of Gravel	0.00
Fine Soil %	**100.00**
Fine Soil Consists of:—	
4—3 mm.	0.00
3—2 ,,	0.06
2—1 ,,	0.29
1—0.5 ,,	1.30
0.5 —0.25 ,,	10.94
0.25—0.1 ,,	11.62
0.1 —0.05 ,,	6.66
0.05—0.01 ,,	19.45
0.01>	49.68
Fine-earthy Part Consists of:—	
0.5 —0.25 mm.	11.12
0.25—0.1 ,,	11.81
0.1 —0.05 ,,	6.78
0.25—0.01 ,,	19.77
0.01>	50.52
Fine-earthy Part %	
In Fine Soil	**98.35**
In Orig. Soil	**98.35**

Chemical Constituents

	Weight % Air dry	Weight % Dried 110° c.	Volume % Loose	Volume % Compact
Moisture		4.950	3.391	5.153
Loss on ignition		7.322	4.678	7.245
C. (in humus)				
Total N. (,,)		**0.566**	**0.330**	**0.532**
Insoluble residue		**58.971**	**38.396**	**58.350**
SiO_2 Sol. in HCl		0.314	0.204	0.310
SiO_2 Sol. in Na_2CO_3		10.150	6.609	10.044
Sum of SiO_2		**10.464**	**6.813**	**10.354**
Al_2O_3		2.104	1.370	2.082
Fe_2O_3		0.144	0.094	0.143
FeO		2.439	1.588	2.413
Mn_2O_3		0.403	0.262	0.399
CaO		2.024	1.248	2.003
MgO		0.379	0.247	0.375
K_2O		**0.179**	**0.117**	**0.178**
Na_2O		0.211	0.138	0.209
P_2O_5		**0.093**	**0.060**	**0.092**
SO_3		0.064	0.042	0.064
Sulphuric acid Extract				
Al_2O_3 & Fe_2O_3		2.659	1.731	2.631
SiO_2		2.830	1.836	2.790

Absorption Experiment

P_2O_5 Coeficient	889.600		
N. ,,	313.644		
Calculated for Fine Soil		**Calculated for Original Soil**	
K_2O	0.167	K_2O	0.167
P_2O_5	0.087	P_2O_5	0.087
P_2O_5 Absorp.	874.922	P_2O_5 Absorp.	874.922
N. ,,	308.469	N. ,,	308.469

Physical Properties

		Loose	Compact
Specific Gravity		2.422	
Weight of 100 cc.		68.50	104.10
Volume Weight (Apparent Sp. Gr.)		0.649	0.986
100 Gr., soil settled in water cc.		160.00	
Weight of soil for filling 100 cc. under water		62.55	
Water Capacity, Weight %		47.33	32.62
Solid Part %		26.79	40.71
Pores %		73.21	59.29
Water capacity, Vol. %		30.70	32.17
In air dry soil (Max. permeability)		69.59	53.80
In water saturated soil (Min. permeability)		42.51	27.12
Time required for imbibing water to the height of 10 cm.		33′	3h 05′
Per Hecter to the depth 10 cm. in water saturated state containing	Air cbm.	425.09	271.24
	Water cbm.	307.05	321.68
Mechanical Composition of Fine-earthy part in 100 cc.	0.5-0.25mm.	7.62	11.58
	0.25-0.1 ,,	8.09	12.29
	0.1 -0.05 ,,	4.64	7.06
	0.05-0.01 ,,	13.54	19.54
	0.01> ,,	34.61	52.59
In 100 cc.	C. (In humus)		
	Hygros. Water	3.62	5.50

Remark:—

A typical soil of Tokachi plain

640

Kind of Soil. Sandy Loam (Lapilli)

Locality. Gotemba, Suruga

Mechanical Compositions

Over 10 mm.	0.17
10—8 „	0.52
8—6 „	1.20
6—4 „	4.23
Sum of Gravel	6.42
Fine Soil %	**93.58**
Fine Soil Consists of:—	
4—3 mm.	1.68
3—2 „	8.08
2—1 „	14.10
1—0.5 „	10.27
0.5—0.25 „	6.20
0.25—0.1 „	3.76
0.1—0.05 „	3.77
0.05—0.01 „	20.62
0.01>	31.52
Fine-earthy Part Consists of:—	
0.5—0.25 mm.	9.41
0.25—0.1 „	5.71
0.1—0.05 „	5.72
0.05—0.01 „	31.31
0.01>	47.85
Fine-earthy Part %	
In Fine Soil	**65.87**
In Orig. Soil	**61.64**

Chemical Constituents

	Weight % Air dry	Weight % Dried 110° c.	Volume % Loose	Volume % Compact
Moisture		7.025	5.152	7.355
Loss on ignition		13.418	9.149	13.061
C. (in humus)				
Total N. („)		**0.904**	**0.571**	**0.814**
Insoluble residue		**45.515**	**31.036**	**44.307**
SiO_2 Sol. in HCl		0.101	0.069	0.098
SiO_2 Sol. in Na_2CO_3		18.369	12.520	17.882
Sum of SiO_2		**18.470**	**12.595**	**17.980**
Al_2O_3		6.453	4.400	6.244
Fe_2O_3		1.459	0.944	1.333
FeO		4.993	3.404	4.860
Mn_2O_3		0.679	0.463	0.661
CaO		3.102	2.115	3.020
MgO		1.510	1.030	1.470
K_2O		**0.236**	**0.161**	**0.229**
Na_2O		0.151	0.103	0.147
P_2O_5		**0.055**	**0.037**	**0.053**
SO_3		0.102	0.070	0.099
Sulphuric acid Extract				
Al_2O_3 & Fe_2O_3		2.500	1.704	2.433
SiO_2		1.229	0.838	1.197

Absorption Experiment

P_2O_5 Coeficient	1728.000
N. „	541.749

Calculated for Fine Soil		Calculated for Original Soil	
K_2O	0.144	K_2O	0.135
P_2O_5	0.034	P_2O_5	0.031
P_2O_5 Absorp.	1138.233	P_2O_5 Absorp.	1065.139
N. „	356.850	N. „	333.934

Physical Properties

		Loose	Compact
Specific Gravity		2.620	
Weight of 100 cc.		73.34	104.70
Volume Weight (Apparent Sp. Gr.)		0.682	0.973
100 Gr., soil settled in water cc.		140.00	
Weight of soil for filling 100 cc. under water		71.43	
Water Capacity, Weight %		96.62	65.61
Solid Part %		26.03	37.15
Pores %		73.97	62.85
Water Capacity, Vol. %		65.88	63.87
In air dry soil (Max. permeability)		68.82	55.49
In water saturated soil (Min. permeability)		8.09	1.02
Time required for imbibing water to the height of 10 cm.		15′	1^h 34′
Per Hecter to the depth 10 cm. in water saturated state containing	Air cbm.	80.91	10.22
	Water cbm.	658.83	638.68
Mechanical Composition of Fine-earthy Part in 100 cc.	0.5-0.25 mm.	6.90	9.84
	0.25-0.1 „	4.19	5.98
	0.1-0.05 „	4.20	5.99
	0.05-0.01 „	22.96	32.78
	0.01> „	35.09	50.10
In 100 cc.	C. (In humus)		
	Hygros. Water	5.152	7.366

Remark:—

Cultivated land at the foot of Fuji volcano

641

Kind of Soil. Schottery Loam (Palaeozoic Pyroxenite)

Locality. Yamadahara, Kii.

Mechanical Compositions

Over 10 mm.	26.08
10—8 „	4.48
8—6 „	3.56
6—4 „	4.69
Sum of Gravel	38.81
Fine Soil %	**61.19**
Fine Soil Consists of:—	
4—3 mm.	3.41
3—2 „	7.29
2—1 „	10.34
1—0.5 „	8.61
0.5—0.25 „	5.98
0.25—0.1 „	9.41
0.1—0.05 „	5.31
0.05—0.01 „	13.06
0.01>	36.59
Fine-earthy Part Consists of:—	
0.5—0.25 mm.	8.50
0.25—0.1 „	13.38
0.1—0.05 „	7.55
0.05—0.01 „	18.56
0.01>	52.01
Fine-earthy Part %	
In Fine Soil	**70.35**
In Orig. Soil	**43.05**

Chemical Constituents

	Weight % Air dry	Weight % Dried 110° c.	Volume % Loose	Volume % Compact
Moisture		4.800	3.285	6.804
Loss on ignition		5.567	3.628	7.513
C. (in humus)				
Total N. („)				
Insoluble residue		**41.329**	**26.932**	**55.762**
SiO_2 Sol. in HCl		0.776	0.506	1.048
SiO_2 Sol. in Na_2CO_3		29.175	19.012	39.371
Sum of SiO_2		**29.951**	**19.518**	**40.416**
Al_2O_3		5.515	3.594	7.442
Fe_2O_3		4.965	3.236	6.701
FeO		4.554	2.967	6.145
Mn_2O_3		0.144	0.094	0.194
CaO		1.334	0.869	1.800
MgO		4.229	2.756	5.707
K_2O		**0.175**	**0.114**	**0.237**
Na_2O		0.076	0.049	0.102
P_2O_5		**0.296**	**0.143**	**0.400**
SO_3		0.050	0.033	0.068
Sulphuric acid Extract				
Al_2O_3 & Fe_2O_3		5.871	3.826	7.922
SiO_2		6.325	4.118	8.536

Absorption Experiment

P_2O_5 Coeficient	889.600
N. „	813.644

Calculated for Fine Soil		Calculated for Original Soil	
K_2O	0.177	K_2O	0.072
P_2O_5	0.198	P_2O_5	0.121
P_2O_5 Absorp.	625.832	P_2O_5 Absorp.	382.973
N. „	220.649	N. „	135.024

Physical Properties

		Loose	Compact
Specific Gravity		2.808	
Weight of 100 cc.		68.45	141.75
Volume Weight (Apparent Sp. Gr.)		0.652	1.350
100 Gr., soil settled in water cc.		118.00	
Weight of soil for filling 100 cc. under water		84.80	
Water Capacity, Weight %		53.33	38.69
Solid Part %		23.21	48.06
Pores %		76.80	51.65
Water Capacity, Vol. %		34.75	52.21
In air dry soil (Max. permeability)		73.51	45.14
In water saturated soil (Min. permeability)		42.04	0.73
Time required for imbibing water to the height of 10 cm.		1h 44′	6h 36′
Per Hecter to the depth 10 cm. in water saturated state containing	Air cbm.	420.44	7.31
	Water cbm.	347.51	522.14
Mechanical Composition of Fine-earthy part in 100 cc.	0.5-0.25mm.	5.82	12.05
	0.25-0.1 „	9.16	18.97
	0.1-0.05 „	5.17	10.70
	0.05-0.01 „	12.70	26.31
	0.01> „	35.60	73.72
In 100 cc.	C. (In humus)		
	Hygros Water	3.29	6.80

Remark:—

A well known Mikan (Citrus nobilis) district of Japan

642

Kind of Soil. Schottery Loam, (Palaeozoic Slate)

Locality. Uji, Yamashiro

Mechanical Compositions		Chemical Constituents	Weight % Air dry	Weight % Dried 110° C.	Volume % Loose	Volume % Compact	Physical Properties	Loose	Compact
Over 10 mm.	10.06	Moisture		3.210	2.893	4.599	Specific Gravity	2.627	
10—8 ,,	2.60	Loss on ignition		5.197	4.533	7.206	Weight of 100 cc.	90.11	143.26
8—6 ,,	1.97	C. (in humus)					Volume Weight (Apparent Sp. Gr.)	0.872	1.387
6—4 ,,	3.53	Total N. (,,)		**0.251**	**0.219**	**0.348**	100 Gr., soil settled in water cc.	112.00	
Sum of Gravel	18.16	Insoluble residue		**73.944**	**64.492**	**102.531**	Weight of soil for filling 100 cc. under water	89.28	
Fine soil %	**81.84**	SiO_2 Sol. in HCl		0.163	0.142	0.226	Water Capacity, Weight %	52.68	35.61
Fine Soil Consists of:—		SiO_2 Sol. in Na_2CO_3		11.967	10.437	16.594	Solid Part %	33.19	52.80
4—3 mm.	2.56	Sum of SiO_2		**12.130**	**10.579**	**16.820**	Pores %	66.81	47.20
3—2 ,,	5.52	Al_2O_3		3.482	3.037	4.828	Water Capacity, Vol. %	45.94	49.39
2—1 ,,	14.18	Fe_2O_3		1.306	1.139	1.811	In air dry soil (Max. permeability)	63.91	42.60
1—0.5 ,,	19.14	FeO		0.391	0.341	0.542	In water saturated soil (Min. permeability)	20.87	-2.19
0.5 —0.25 ,,	10.16	Mn_2O_3		0.342	0.298	0.474	Time required for imbibing water to the height of 10 cm.	28′	1h 37′
0.25—0.1 ,,	6.46	CaO		0.460	0.401	0.638			
0.1 —0.05 ,,	4.32	MgO		0.425	0.370	0.589	Per Hecter to the depth 10 cm. in water saturated state containing: Air cbm.	208.66	-21.85
0.05—0.01 ,,	9.30	K_2O		**0.023**	**0.020**	**0.032**			
0.01>	28.36	Na_2O		0.023	0.020	0.032	Water cbm.	459.40	493.87
Fine-earthy Part Consists of:—		P_2O_5		**0.326**	**0.285**	**0.453**	Mechanical Composition of Fine-earthy part in 100 cc.: 0.5-0.25 mm.	15.63	24.84
0.5 —0.25 mm.	17.34	SO_3		0.073	0.064	0.102	0.25-0.1 ,,	9.93	15.79
0.25—0.1 ,,	11.02	Sulphuric acid Extract					0.1 -0.05 ,,	6.64	10.56
0.1 —0.05 ,,	7.37	Al_2O_3 & Fe_2O_3		3.739	3.261	5.185	0.05-0.01 ,,	14.30	22.74
0.05—0.01 ,,	15.87	SiO_2		4.271	3.725	5.922	0.01> ,,	43.61	69.34
0.01>	48.40	Absorption Experiment					In 100 cc.: C. (In humus)		
Fine-earthy Part %		P_2O_5 Coeficient			339.200		Hygros. Water	2.89	4.60
In Fine Soil	**58.60**	N. ,,			194.636				
In Orig. Soil	**47.96**	Calculated for Fine Soil		Calculated for Original Soil					
		K_2O	0.013	K_2O		0.011			
		P_2O_5	0.185	P_2O_5		0.152			
		P_2O_5 Absorp.	198.771	P_2O_5 Absorp.		162.680			
		N. ,,	114.057	N. ,,		93.347			

Remark:—

A famous tea district producing tea of fine quality

643

Kind of Soil. Schottery Loam (Mesozoic Shale)

Locality. Amakusa, Higo

Mechanical Compositions

Over 10 mm.	9.61
10—8 „	4.54
8—6 „	4.35
6—4 „	7.08
Sum of Gravel	25.58
Fine Soil %	**74.42**
Fine Soil Consists of:—	
4—3 mm.	4.06
3—2 „	10.23
2—1 „	14.85
1—0.5 „	11.97
0.5 —0.25 „	7.01
0.25—0.1 „	3.69
0.1 —0.05 „	4.95
0.05—0.01 „	6.96
0.01>	36.28
Fine-earthy Part Consists of:—	
0.5 —0.25 mm.	11.90
0.25—0.1 „	6.27
0.1 —0.05 „	8.41
0.05—0.01 „	11.82
0.01>	61.61
Fine-earthy Part %	
In Fine Soil	**38.89**
In Orig. Soil	**43.83**

Chemical Constituents

	Weight % Air dry	Weight % Dried 110° c.	Volume % Loose	Volume % Compact
Moisture		5.175	4.656	7.537
Loss on ignition		4.746	4.049	6.554
C. (in humus)				
Total N. („)				
Insoluble residue		**75.326**	**64.271**	**104.035**
SiO_2 Sol. in HCl		0.085	0.073	0.118
SiO_2 Sol. in Na_2CO_3		6.256	5.338	8.640
Sum of SiO_2		**6.341**	**5.411**	**8.758**
Al_2O_3		4.218	3.600	5.828
Fe_2O_3		3.503	2.989	4.840
FeO		1.851	1.679	2.557
Mn_3O_4		0.404	0.345	0.558
CaO		0.429	0.366	0.593
MgO		0.717	0.612	0.991
K_2O		**0.131**	**0.112**	**0.181**
Na_2O		0.175	0.149	0.242
P_2O_5		**0.053**	**0.045**	**0.077**
SO_3		0.028	0.024	0.039
Sulphuric acid Extract				
Al_2O_3 & Fe_2O_3		10.384	8.860	14.342
SiO_2		7.363	6.282	10.169

Absorption Experiments

P_2O_5 Coeficient	395.52
N. „	299.39

Calculated for Fine Soil		Calculated for Original Soil	
K_2O	0.073	K_2O	0.054
P_2O_5	0.029	P_2O_5	0.022
P_2O_5 Absorp.	233.926	P_2O_5 Absorp.	173.356
N. „	176.311	N. „	131.224

Physical Properties

	Loose	Compact
Specific Gravity	2.796	
Weight of 100 cc.	89.98	145.65
Volume Weight (Apparent Sp. Gr.)	0.8486	1.3737
100 Gr., soil settled in water cc.	118.00	
Weight of soil for filling 100 cc. under water	83.05	
Water Capacity, Weight %	55.99	35.08
Solid Part %	30.35	49.13
Pores %	69.65	50.87
Water Capacity, Vol. %	47.51	48.19
In air dry soil (Max. permeability)	64.53	42.38
In water saturated soil (Min. permeability)	22.13	2.68
Time required for imbibing water to the height of 10 cm.	1^h 40′	13^h 00′
Per Hecter to the depth 10 cm. in water saturated state containing — Air cbm.	221.33	26.79
Per Hecter to the depth 10 cm. in water saturated state containing — Water cbm.	475.15	481.89
Mechanical Composition of Fine-earthy part in 100 cc. — 0.5-0.25 mm.	10.71	17.33
0.25-0.1 „	6.64	9.13
0.1 -0.05 „	7.56	12.24
0.05-0.01 „	10.63	25.75
0.01> „	55.39	89.70
In 100 cc. — C. (In humus)		
In 100 cc. — Hygros. Water	5.12	8.28

Remark:—

A typical soil of the most esteemed Sugar cane field

644

Kind of Soil. Loamy Sand (Granite)

Locality. Ogyū, Mikawa

Mechanical Compositions

Over 10 mm.	0.21
10—8 „	0.50
8—6 „	0.96
6—4 „	3.90
Sum of Gravel	5.57
Fine Soil %	**94.43**
Fine Soil Consists of:—	
4—3 mm.	2.47
3—2 „	9.63
2—1 „	14.94
1—0.5 „	14.54
0.5 —0.25 „	14.00
0.25—0.1 „	9.29
0.1 —0.05 „	8.59
0.05—0.01 „	8.71
0.01>	17.83
Fine-earthy Part Consists of:—	
0.5 —0.25 mm.	23.96
0.25—0.1 „	15.90
0.1 —0.05 „	14.70
0.05—0.01 „	14.91
0.01>	30.51
Fine-earthy Part %	
In Fine Soil	**58.42**
In Orig. Soil	**55.17**

Chemical Constituents

	Weight % Air dry	Weight % Dried 110° c.	Volume % Loose	Volume % Compact
Moisture		2.700	2.392	3.696
Loss on ignition		4.368	3.765	5.818
C. (in humus)				
Total N. („)		**0.366**	**0.306**	**0.473**
Insoluble residue		**70.705**	**60.953**	**94.182**
SiO_2 Sol. in HCl		0.547	0.171	0.728
SiO_2 Sol. in Na_2CO_3		9.669	8.329	12.829
Sum of SiO_2		**10.216**	**8.500**	**13.557**
Al_2O_3		4.625	3.987	6.161
Fe_2O_3		2.962	2.553	3.945
FeO		2.211	1.906	2.945
Mn_2O_3		0.904	0.781	1.205
CaO		0.381	0.329	0.508
MgO		0.851	0.734	1.134
K_2O		**0.155**	**0.134**	**0.207**
Na_2O		0.116	0.100	0.155
P_2O_5		**0.065**	**0.056**	**0.086**
SO_3		0.048	0.042	0.057
Sulphuric acid Extract				
Al_2O_3 & Fe_2O_3		2.084	1.797	2.776
SiO_2		3.143	2.679	4.187

Absorption Experiment

P_2O_5 Coeficient		395.520	
N. „		105.498	
Calculated for Fine Soil		Calculated for Original Soil	
K_2O	0.088	K_2O	0.083
P_2O_5	0.037	P_2O_5	0.035
P_2O_5 Absorp.	231.063	P_2O_5 Absorp.	219.538
N. „	69.632	N. „	58.203

Physical Properties

		Loose	Compact
Specific Gravity		2.680	
Weight of 100 cc.		88.60	136.90
Volume Weight (Apparent Sp. Gr.)		0.863	1.333
100 Gr., soil settled in water cc.		115.00	
Weight of soil for filling 100 cc. under water		86.97	
Water Capacity, Weight %		57.15	32.99
Solid Part %		32.13	49.72
Pores %		67.87	50.28
Water Capacity, Vol. %		49.29	43.96
In air dry soil (Max. permeability)		65.52	46.66
In water saturated soil (Min. permeability)		18.57	6.32
Time required for imbibing water to the height of 10 cm.		23′	3h 08′
Per Hecter to the depth 10 cm. in water saturated state containing	Air cbm.	185.70	63.21
	Water cbm.	492.95	439.63
Mechanical Composition of Fine-earthy part in 100 cc.	0.5-0.25mm.	21.23	32.80
	0.25-0.1 „	14.09	21.77
	0.1 -0.05 „	13.02	20.12
	0.05-0.01 „	13.21	20.41
	0.01> „	27.03	41.77
In 100 cc.	C. (in humus)		
	Hygros. Water	2.34	3.62

Remark:—

Soil of the productive paddy field

645

Kind of Soil. Loamy Sand (Granitic Gneiss)

Locality. Nihonmatsu, Iwashiro

Mechanical Compositions

Over 10 mm.	0.00
10—8 "	0.00
8—6 "	0.00
6—4 "	0.01
Sum of Gravel	0.01
Fine Soil %	**99.99**
Fine Soil Consists of:—	
4—3 mm.	0.24
3—2 "	1.90
2—1 "	11.30
1—0.5 "	21.92
0.5 —0.25 "	16.24
0.25—0.1 "	7.88
0.1 —0.05 "	15.66
0.05—0.01 "	11.06
0.01>	13.80
Fine-earthy Part Consists of:—	
0.5 —0.25 mm.	25.12
0.25—0.1 "	12.19
0.1 —0.05 "	24.24
0.05—0.01 "	17.11
0.01>	21.34
Fine-earthy Part %	
In Fine Soil	**64.64**
In Orig. Soil	**64.63**

Chemical Constituents

	Weight % Air dry	Weight % (Dried 110° c.)	Volume % Loose	Volume % Compact
Moisture		3.410	3.052	4.542
Loss on ignition		6.005	5.192	7.727
C. (in humus)				
Total N. (")		**0.104**	**0.090**	**0.133**
Insoluble residue		**58.447**	**50.532**	**75.208**
SiO_2 Sol. in HCl		0.508	0.439	0.654
SiO_2 Sol. in Na_2CO_3		17.130	14.810	22.043
Sum of SiO_2		**17.638**	**15.249**	**22.697**
Al_2O_3		8.448	7.304	10.871
Fe_2O_3		3.806	3.290	4.897
FeO		1.576	1.357	2.020
Mn_2O_3		0.547	0.473	0.703
CaO		1.492	1.264	1.893
MgO		1.507	1.285	1.913
K_2O		**0.296**	**0.256**	**0.381**
Na_2O		0.072	0.062	0.092
P_2O_5		**0.221**	**0.193**	**0.288**
SO_3		0.049	0.042	0.063
Sulphuric acid Extract				
Al_2O_3 & Fe_2O_3		4.885	4.224	6.253
SiO_2		1.906	1.648	2.453

Absorption Experiment

P_2O_5 Coeficient	704.000
N. "	182.506

Calculated for Fine Soil		Calculated for Original Soil	
K_2O	0.185	K_2O	0.185
P_2O_5	0.140	P_2O_5	0.140
P_2O_5 Absorp.	455.066	P_2O_5 Absorp.	454.995
N. "	117.972	N. "	117.954

Physical Properties

		Loose	Compact
Specific Gravity		2.714	
Weight of 100 cc.		89.51	133.22
Volume Weight (Apparent Sp. Gr.)		0.865	1.287
100 Gr., soil settled in water cc.		102.5	
Weight of soil for filling 100 cc. under water		97.56	
Water Capacity, Weight %		62.23	39.64
Solid Part %		31.87	47.42
Pores %		68.13	52.58
Water Capacity, Vol. %		54.83	51.02
In air dry soil (Max. permeability)		65.08	48.04
In water saturated soil (Min. permeability)		34.95	16.14
Time required for imbibing water to the height of 10 cm.		20′	1ʰ 35′
Per Hecter to the depth 10 cm. in water saturated state containing	Air cbm.	349.50	161.42
	Water cbm.	548.25	510.19
Mechanical Composition of Fine-earthy part in 100 cc.	0.5–0.25 mm.	22.49	33.50
	0.25–0.1 "	10.91	16.24
	0.1–0.05 "	21.70	32.29
	0.05–0.01 "	15.32	22.79
	0.01> "	19.10	28.49
In 100 cc.	C. (In humus)		
	Hygros. Water	3.052	4.542

Remark:—

Soil of the most esteemed mulberry ground

646

Kind of Soil. Loamy Sand (Young Quaternary)

Locality. Kurihashi, Musashi

Mechanical Compositions

Over 10 mm.	0.00
10—8 „	0.00
8—6 „	0.00
6—4 „	0.00
Sum of Gravel	0.00
Fine Soil %	**100.00**
Fine Soil Consists of:—	
4—3 mm.	0.00
3—2 „	0.02
2—1 „	0.12
1—0.5 „	5.52
0.5 —0.25 „	32.24
0.25—0.1 „	9.43
0.1 —0.05 „	24.79
0.05—0.01 „	10.38
0.01>	7.50
Fine-earthy Part Consists of:—	
0.5 —0.25 mm.	34.17
0.25—0.1 „	10.00
0.1 —0.05 „	26.28
0.05—0.01 „	11.00
0.01>	18.55
Fine-earthy Part %	
In Fine Soil	**94.34**
In Orig. Soil	**94.34**

Chemical Constituents

	Weight % Air dry	Weight % Dried 110° c.	Volume % Loose	Volume % Compact
Moisture		2.702	3.040	4.150
Loss on Ignition		3.580	3.842	5.257
C. (in humus)				
Total N. („)		**0.394**	**0.423**	**0.578**
Insoluble residue		**73.199**	**78.572**	**107.493**
SiO_2 Sol. in HCl		0.576	0.618	0.846
SiO_2 Sol. in Na_2CO_3		9.281	9.962	13.629
Sum of SiO_2		**9.857**	**10.580**	**14.475**
Al_2O_3		5.346	5.738	7.851
Fe_2O_3		2.846	3.055	4.179
FeO		2.213	2.375	3.250
Mn_2O_3		0.287	0.308	0.421
CaO		1.457	1.564	2.140
MgO		0.844	1.906	1.239
K_2O		**0.287**	**0.308**	**0.421**
Na_2O		0.174	0.187	0.256
P_2O_5		**0.083**	**0.089**	**0.122**
SO_3		0.031	0.035	0.046
Sulphuric acid Extract				
Al_2O_3 & Fe_2O_3		1.770	1.900	2.599
SiO_2		2.477	2.659	3.637

Absorption Experiments

P_2O_5 Coeficient	657.850
N. „	58.164

Calculated for Fine Soil		Calculated for Original Soil	
K_2O	0.264	K_2O	0.264
P_2O_5	0.764	P_2O_5	0.764
P_2O_5 Absorp.	620.616	P_2O_5 Absorp.	620.616
N. „	54.872	N. „	54.872

Physical Properties

		Loose	Compact
Specific Gravity		2.702	
Weight of 100 cc.		110.38	151.00
Volume Weight (Apparent Sp. Gr.)		1.073	1.468
100 Gr., soil settled in water cc.		95.00	
Weight of soil for filling 100 cc. under water		105.26	
Water Capacity, Weight %		43.09	29.72
Solid Part %		39.73	54.33
Pores %		60.28	45.67
Water Capacity, Vol. %		46.23	43.63
In air dry soil (Max. permeability)		57.24	41.52
In water saturated soil (Min. permeability)		14.04	2.04
Time required for imbibing water to the height of 10 cm.		15′	2h 25′
Per Hecter to the depth 10 cm. in water saturated state containing	Air cbm.	140.41	20.44
	Water cbm.	462.34	436.27
Mechanical Composition of Fine-earthy part in 100 cc.	0.5—0.25 mm.	37.72	51.60
	0.25—0.1 „	11.04	15.10
	0.1 —0.05 „	29.01	39.68
	0.05—0.01 „	12.14	16.61
	0.01> „	20.48	28.01
In 100 cc.	C. (In humus)		
	Hygros. Water	3.04	4.15

Remark:—

A typical Soil most suited for Rice field

647

Kind of Soil. Loamy Schotter (Mesozoic Sandstone.)

Locality. Ono, Tosa

Mechanical Compositions

Over 10 mm.	29.17
10—8 „	8.00
8—6 „	8.77
6—4 „	12.90
Sum of Gravel	58.84
Fine Soil %	**41.16**
Fine Soil Consists of:—	
4—3 mm.	16.78
3—2 „	12.82
2—1 „	5.74
1—0.5 „	2.72
0.5—0.25 „	3.08
0.25—0.1 „	4.58
0.1—0.05 „	7.76
0.05—0.01 „	13.14
0.01>	33.38
Fine-earthy Part Consists of:—	
0.5—0.25 mm.	4.97
0.25—0.1 „	7.39
0.1—0.05 „	12.53
0.05—0.01 „	21.21
0.01>	53.89
Fine-earthy Part %	
In Fine Soil	**61.94**
In Orig. Soil	**25.49**

Chemical Constituents

	Weight % Air dry	Weight % Dried 110° C.	Volume % Loose	Volume % Compact
Moisture		7.520	6.785	9.475
Loss on ignition		7.645	6.379	8.908
C. (in humus)				
Total N. („)		**0.088**	**0.073**	**0.102**
Insoluble residue		**39.504**	**32.960**	**46.030**
SiO_2 Sol. in HCl		0.322	0.269	0.406
SiO_2 Sol. in Na_2CO_3		30.180	25.183	35.167
Sum of SiO_2		**30.502**	**25.452**	**35.573**
Al_2O_3		14.760	12.316	17.199
Fe_2O_3		4.445	3.709	5.180
FeO		1.891	1.578	2.204
Mn_2O_3		0.481	0.402	0.561
CaO		0.868	0.725	1.012
MgO		0.953	0.795	1.110
K_2O		**0.097**	**0.081**	**0.113**
Na_2O		0.010	0.008	0.011
P_2O_5		**0.103**	**0.086**	**0.120**
SO_3		0.005	0.005	0.006
Sulphuric acid Extract				
Al_2O_3 & Fe_2O_3		4.240	3.538	4.941
SiO_2		0.973	0.812	1.021

Absorption Experiment

P_2O_5 Coeficient	1024 000
N. „	262.707

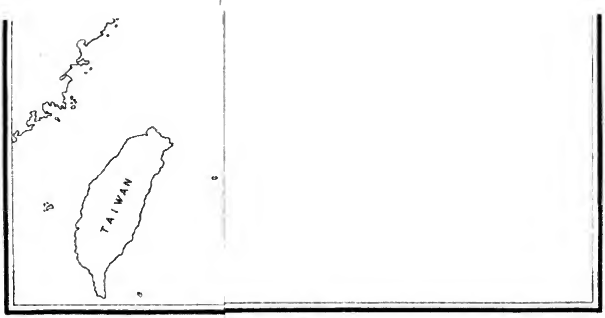
Calculated for Fine Soil		Calculated for Original Soil	
K_2O	0.056	K_2O	0.022
P_2O_5	0.059	P_2O_5	0.024
P_2O_5 Absorp.	634.266	P_2O_5 Absorp.	261.018
N. „	162.721	N. „	66.964

Physical Properties

	Loose	Compact
Specific Gravity	2.648	
Weight of 100 cc.	90.23	126.00
Volume Weight (Apparent Sp. Gr.)	0.834	1.165
100 Gr., soil settled in water cc.	128.00	
Weight of soil for filling 100 cc. under water	78.125	
Water Capacity, Weight %	70.20	46.59
Solid Part %	31.49	43.99
Pores %	68.51	56.01
Water capacity, Vol. %	58.55	54.28
In air dry soil (Max. permeability)	61.72	46.53
In water saturated soil (Min. permeability)	9.96	1.73
Time required for imbibing water to the height of 10 cm.	1ʰ 10′	5ʰ 01′
Per Hecter to the depth to cm. in water saturated state containing Air cbm.	99.58	17.29
Per Hecter to the depth to cm. in water saturated state containing Water cbm.	585.47	542.79
Mechanical Composition of Fine-earthy part in 100 cc. 0.5–0.25 mm.	4.48	6.26
0.25–0.1 „	6.67	9.31
0.1–0.05 „	11.31	15.79
0.05–0.01 „	19.14	26.72
0.01> „	48.62	67.90
In 100 cc. C. (In humus)		
In 100 cc. Hygros. Water	6.79	9.48

Remark:—

A well known Paper Mulberry (Bronssonetia papyrifera) district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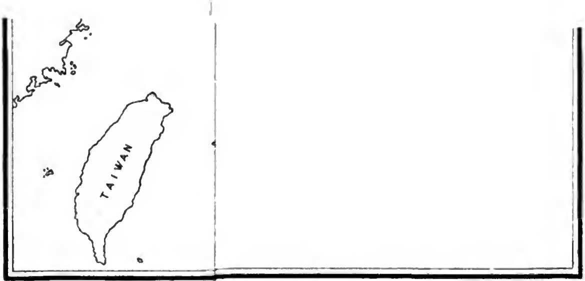
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